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AMERICAN FOUNDRYMEN'S ASSOCIATION

SHOP MANAGEMENT

By H. F. J. PORTER, New York City

It seems almost unnecessary to say, in the face of the intelligence represented in the management of manufacturing enterprises nowadays, that better results are attainable in a shop where neatness and orderly methods are maintained than where the reverse is the case. And yet it is surprising how many shops there are whose physical conditions are such that not only can work not be performed economically in them, but where good mechanics would have to work under such handicaps that they actually refuse to go there.

There is a difference in people's conceptions of what constitute neatness and order. What one man would term good conditions another would term impossible. Some men are affected by what they have been accustomed to, others can put up with certain inconveniences provided they are well paid, and still others will work under all sorts of disadvantages provided they are well treated. It is largely a matter of temperament and education.

I met a friend a short time ago who I knew had quite a good sized plant, although I had never had an opportunity to visit it. I knew that this man had made money there, and that he took pride in the way he treated his men. He said he had never been as busy as he was then and wondered why everybody was complaining about dull times. After that when men applied to me for work I referred them to his shop and great was my astonishment to have them come back, to tell me that they had too much self-respect to work in such a place.

Accordingly I took an early opportunity to visit it, and I found it to be very much as these men had described it, viz: a tumble-down shed, the floor worn through to the ground in front of every machine, line shafting wobbling so that the belts had to be held on the pulleys by guide sticks. Window panes so dirty that scarcely any light came through them. Holes in

the roof admitted streams of water from melting snow. Men were sitting around smoking in dark corners, and altogether I think I never got into such a woe-begone, neglected, unorganized place anywhere before.

My friend the owner was not there to show me around, but his representative was on hand and acted as a very genial guide

Some days afterwards when I saw the owner he said to me, "Well, don't you think we have things about perfect down there?" I really did not know how to reply so I sparred for time. I asked if his men were steady and to my surprise he said that out of an average of about one hundred men the year round, he had an old guard of about eighty, and that from these he did not think he had lost one in over five years, and many had been with him for twenty years. His secret was in being absolutely square with his men and with his customers, and as a result his shop was full of work at good prices and he was apparently making money. Of course there was wastefulness at every turn, and as he never spent a cent for improvements and seldom for repairs, some day his plant will be worn out and if he wants to continue in business he will have to renew his entire equipment, buildings included.

Here was an extreme case, a lap over from a preceding generation. So I may say that we cannot always judge results by appearances, and that people's ideas of what good conditions are vary materially and are purely comparative.

I have found, in my experience with reorganization work in factories, that there are no hard and fast rules to be applied to all works. Each plant presents a complex problem of its own which has to be analyzed, studied and solved by itself. But in every case there is one element which must be reckoned with and that is human nature. We must learn from the lessons which experience teaches, and pay heed to precedent, if we wish to succeed in our industrial and commercial ventures. Especially must we recognize the common interests of the others who are involved in our enterprise and give them the means of expressing their wishes in order that harmony of action between them and us may be attained, and we all may work together for the same end. Here was the key to the success of the man above mentioned. It was virtually one big family working for a common interest under the paternal care of a big

man. What will happen when this man dies is another matter. Probably the works will close.

It is an interesting question in each case to decide what type of management will secure the best results. It used to depend largely upon the Manager's knowledge of all the details of the business. Nowadays, however, the work is so specialized that one man cannot know it all, and consequently a more diversified system of management becomes necessary.

I shall never forget a conversation I once had with a Japanese Naval Officer who was sent here some time ago to negotiate with Cramps Shipyard for some battle ships for his government. We were discussing the relative merits of the Monarchic and Democratic forms of government and his analysis of their respective merits ran somewhat as follows:

"In the Monarchic form as represented in Japan, China, Russia and similar countries, the future ruler is born gifted, from whatever there may be in heredity, with a tendency to rule. This tendency is fostered by his parents while he is a child, and as he grows to manhood the idea that he is to rule, and must prepare himself for that duty is persistently instilled in him by all with whom he comes in contact. He is constantly surrounded by and associates with those who are engaged in affairs of moment so that he becomes gradually familiar with the vital questions of the nation."

"When it finally devolves upon him to assume the throne he finds his training has equipped him to take the reins of government from the hands of his predecessor so that there is no stopping of the chariot of state. When a crisis arises he calls together his counsellors who are the same as those of his predecessor and who have been in office for years, to whom the questions at issue are perfectly familiar, and not only is a decision arrived at intelligently and promptly but action upon it is immediate and positive. The crisis is met."

"Now how do these methods compare with those under the Democratic form of government? Here no man is born with any hereditary tendency to rule. No one has any special training during his early life in affairs of national or international importance except as he may study them or perhaps be fortunate enough to take an unimportant part in their details in some subordinate capacity."

"When by a fortuitous combination of circumstances some one is elected to the Presidential Chair he finds himself confronted by questions with which he has no intimate acquaintance. To help him in the solution of these great problems he surrounds himself with a Cabinet composed of men, selected not on account of their special qualifications for their respective portfolios, but to whom his party is obligated for political services rendered. When a crisis arises he calls this Cabinet together to consider the situation and these men endeavor to advise him in accordance with the dictates of their best judgment. Having reached a conclusion he sends a message embodying his recommendations to Congress, which may or may not be in session at the time."

"This body, when it has the opportunity to consider the subject, takes its time to deliberate. There are the usual barter and trade of party votes. Some men will favor the measure provided certain matters of interest to their constituents are favorably considered and after some weeks of lively debate a bill is passed."

"Meanwhile the crisis may have long since culminated."

Now what was the deduction which my Japanese friend drew from his comparison of these two systems of government? He said "I have looked back over the history of the growth of countries which have been controlled by these two systems respectively, and I am compelled to decide in spite of the theory, and that viewed from actual experience the democratic system is the best. Japan is taking active measures to adopt its principles."

Now, concretely, what is there fundamental in this system, which we can incorporate in the methods of governing our Industrial Organizations? For we must recognize the fact that the principles of government are the same whether a large or small number of people to be governed is involved.

At present in our system of education, there is no method of educating any one to manage, and so we find that in the ultimate analysis it is the judgment of *the whole*, of all those, whose common interests are at stake which by its expression becomes of greater potential value *in the long run* than the more contracted one-sided judgment of *a part*, which becomes self-interested at the expense of the remainder. This is government by public opinion.

In "The American Commonwealth" Mr. James Bryce says: "Towering over presidents and state governors, over Congress and state legislatures, over conventions and the vast machinery of party, public opinion stands out in the United States as the great source of power, the master of servants who tremble before it.....It grows up not in Congress, not in state legislatures, not in those great conventions which frame platforms and choose candidates, but at large among people. It is expressed in voices everywhere. It rules as a pervading and impalpable power like the ether which passes through all things. It binds all the parts of the complicated system together and gives them whatever unity of aim and action they possess."

And so in my reorganization work in factories I have found that where there is a tendency to centralize power in a one-man regime the growth of the enterprise is narrowed to just the scope of that one man's capabilities. Whereas if every individual in the organization is given the opportunity and the privilege to express his views and his reasons for them on matters regarding which they may be of value, if whatever there is good in that presented is accepted for what it is worth, then at once the Management is reinforced by the potential knowledge possessed by the brains of the whole organization and the success of the enterprise becomes enormously enhanced.

By practical experience I have found that this result can be secured with very slight disturbances of the regular routine of the shop, if we organize the shop forces on a democratic system of government very similar to that which exists in our states or at the National Capital.

According to this plan there is first formed a lower house, or "Works Committee" composed of representatives elected one from each department of the shop and office. Lots are drawn so that the terms of service of the members cease in rotation so that one drops out each month and a new member is elected in his place. This arrangement allows of a gradual but complete change in the personnel of the Committee in the course of a year or so, and gives many men in the shops a chance to serve. The Chairman is elected by the Committee from its members. The upper house or "Advisory Board" is composed of the shop foremen and the heads of the other departments. These remain permanently in office and are presided over by the General Man-

ager. To provide subjects for these two bodies to consider a "suggestion system" is established. This consists of locked boxes distributed throughout the departments. Through a slot in each can be dropped signed suggestions on proper blanks prepared for the purpose. No anonymous communications are recognized. These suggestions may be on improvements (a) in design, (b) in workmanship or (c) material entering into the product, (d) in processes of manufacture, (e) in methods of business, and (f) in conditions about the shops.

These suggestions are periodically collected by some one selected by the Works Committee as secretary, who copies them with the name of the author removed, submits them to the Works Committee for consideration, and keeps a careful record of the recommendations for adoption or rejection of each.

The minutes of the Committee, consisting of these recommendations, are posted on bulletin boards in the shops and the following week they come before the Advisory Board for consideration. The Chairman of the Works Committee is admitted to the meetings of this Board by courtesy, but without power to vote. These minutes, consisting of the endorsement or rejection of the recommendation of the Works Committee are in turn posted on the bulletin boards in the shops and finally brought to the President by the General Manager for final disposal. An estimate of the cost of installing each is made as well as an estimate of the value to accrue from it, and a balance is struck. All those which are accepted by him are paid for.

It is also found advantageous in some cases to pay quarterly a bonus to the employee making the best or greatest number of suggestions, and to the Foreman from whose department the greatest number emanate. The object in posting the minutes of the meeting in the shops is to insure publicity of the actions on all suggestions submitted. Right here is where public opinion is created and herein lies the success of the system. This publicity tends to retsrain the rank and file from making foolish suggestions and prevents the two Committees from acting otherwise than fairly on what comes before them. It is surprising how the establishment of this system develops and broadens the organization, and tends to make both management and employee look on matters of common interest from a wider angle than before. This closer touch which comes from bringing management

and employee together leads both to think more nearly right and no man need be feared who is conscientious and thinks right.

This more intimate contact tends towards fair treatment from both sides—the employee is recognized as a human being rather than as a machine, the management is looked upon as a friend rather than a tyrant. This closer union produces harmony of action and the so-called "labor question" largely disappears.

"Shop Betterment" by the adoption of carefully considered suggestions by the employees is much more satisfactory than that which comes in a paternal manner from the management as "welfare work." The employee gets only what he can demonstrate that he needs instead of having presented to him by the management what the latter thinks he needs. He thus appreciates what he gets and makes effective use of it.

ADDENDUM

"When I first recount to an employer such experiences as the above and suggest that he should place some responsibility on his men and give them a corresponding amount of authority, I am almost invariably met by the statement that such methods may work in other shops, but that as far as his is concerned he would not trust his men and that undoubtedly the latter would be suspicious of any such move on his part.

"This is the exact situation which exists in most shops and it seems almost unnecessary to say that wherever there is such a mutual lack of confidence it is impossible to have full and willing service, or in other words efficiency is wanting.

"By the introduction of Democratic methods however confidence quickly becomes established, interest in the common welfare of both sides grows and the efficiency of the organization correspondingly increases. It is acknowledged to be most desirable to develop the organization from within, and these methods arouse the personal ambition of the men and bring to the front the best element among them, thus presenting opportunities for promotion and establishing a normal and healthy growth. As the character of the organization improves, its efficiency increases and the prosperity of the Company and of the individuals of the working force becomes enhanced. This is what both were looking for, and as they realize their expectations they become satisfied and happy."

H. F. J. PORTER

CHEMICAL REACTIONS IN FOUNDRY CUPOLA PRACTICE

By JULES DE CLERCY, MONTREAL, P. Q.

New processes, recently developed in view of obtaining motive power through the Agency of gas engines driven with producer gas, have led engineers to give more attention than they had done heretofore, to the complicated chemical reactions taking place at different levels, in a large mass of incandescent fuel, under varying conditions, the results observed in the course of these experiments, happen to apply exactly to the conditions existing in the running of ordinary foundry cupolas. These conditions, as a matter of fact, are absolutely similar to those existing in coke or anthracite producers, considered as burning their own gas, instead of delivering it to a gas engine.

Let us first see what takes place in one of these producers, when run with a dry air blast. The incoming air, blown in through the tuyeres, or under the grate (which is the same thing) first meets a mass of previously heated incandescent coke. The oxygen of this air, combines at first with the carbon of the coal or coke, to form carbonic acid gas, as a result of the complete combustion of the coal or coke. This reaction is expressed by the following chemical equation:

$$C+2O=CO_2$$

which means that the oxygen of the air combines with its equivalent of carbon, to form a volume of carbonic gas equal to its own. In other words, that 32 oz. of oxygen, calling for approximately 140 oz. of air, combine with 12 oz. of carbon, to form 44 oz. of carbonic gas. One pound of carbon burning in this manner, develops 14.500 British thermal units, i. e., a quantity of heat sufficient to raise the temperature of 14500 lbs. of water, one degree Farenheit.

The greater part of this heat is carried upwards by the gases of combustion and goes to heat the upper layers of fuel in the producer (or the layers of iron above, in the case of the cupola).

The mass of fuel into which the tuyeres open and the zone immediately above them, soon reaches a high temperature which keeps on increasing up to a limit of say 1,600° or thereabouts, temperature at which carbonic gas can only form in very limited quantities.

The combustion goes on, nevertheless, but yields more carbon monoxide than anything else (16 oz. of oxygen, furnished by 70 oz. of air, combine with 12 oz. of carbon, to make 28 oz. of carbon monoxide). This imperfect combustion develops much less heat than when the carbon is burnt to carbonic acid gas, for one pound of carbon burnt in this manner only gives 4,400 B. T. U., instead of 14,500 developed by the same weight of carbon in the former reaction. More than two-thirds of the heat actually available in the fuel is lost, and in order to develop the same amount of heat as one pound of carbon burnt to carbonic gas, we have to burn 14,500/4,400, or about 3¼ lbs.

Notwithstanding this loss, there is nevertheless a considerable amount of heat being constantly developed, causing the temperature to go on continually increasing around the tuyeres, and unless a rapid exchange of this heat with some foreign substance is effected at this level, the temperature soon reaches 1800° and 2000° (temperature at which iron melts) and finally 2300°, at which temperature melted iron is rapidly oxidised, or in other words, burnt and made unfit for use.

Long before these temperatures are reached, however, the ashes contained in the fuel have begun to fuse, so that a producer running on coke or anthracite and with a blast of dry cold air, would soon become blocked, as the semi-liquified clinker will prevent the air from penetrating through the mass of fuel. Such a producer cannot therefore be run with a blast of dry cold air.

The coke and the anthracite contain a quantity of pyrites, or iron sulphides; part of the sulphur in them is released at the high temperatures existing in the mass and this sulphur turns into sulphurous acid, the presence of which reveals itself by its characteristic odour of burnt matches. (In producers where a steam blast is used, the free hydrogen combines with the sulphur to form sulphuretted hydrogen which has an odour similar to that of rotten eggs).

The oxide of iron resulting from the decomposition of the

pyrites, combines with the silica, lime and magnesia it meets with in the ashes and in the brick lining the cupola, and forms various silicates, or fusible glasses, which rapidly obstruct the producer and eat away the linings.

In order to prevent the obstruction of the producer in this manner, a mixture of air and steam has to be blown into it. This steam coming into contact with incandescent carbon at a temperature of from 1,600 to 2,000 Far. is entirely dissociated into its elements of hydrogen and oxygen. The oxygen at once combines with the carbon to form carbon monoxide and the hydrogen remains free. The formula expressing this reaction is the following:

$$HO_2+C=2H+CO$$

2 volumes, or 18 oz. of steam, combine with 12 oz. of carbon to give 2 volumes, or 2 oz. of free hydrogen and 2 volumes, or 28 oz. of carbon-monoxide.

This reaction absorbs a considerable amount of heat, and does so in such a manner that if the proportions of air and steam are properly regulated, the heat developed by the combustion due to the air, is entirely absorbed by the dissociation of the steam, and the temperature around the tuyeres will remain constant and can be maintained at a point such that clinker will not melt, or even form at all.

Such is the theory of gas producers, viz., to maintain at the grate bars of the producer (or in the tuyere area for the cupola) a temperature sufficiently high to form a maximum quantity of carbon-monoxide, and yet sufficiently low to prevent the formation of clinker and the rapid disintegration of the brick linings.

The gases coming from the producer, if it were possible to maintain its temperature at 2,000°, would be carbon-monoxide and hydrogen mixed with the nitrogen injected with the air. This would constitute a comparatively rich gas. In practice, however, this is impossible, for the clinkers already become troublesome at 1600°, and it is always desirable to keep the temperature just below this point, especially in cases where the engine draws the air through the producer by the suction of the piston. The temperature being thus kept down, causes a considerable proportion of carbonic acid to form and enter the mixture of nitrogen and combustible gases. This makes a gas not

quite so rich as the former, but it allows of the producer being run satisfactorily, and this is an important point to secure. Instead of injecting steam, carbonic gas could be used for the purpose and with the same advantages. In fact, some builders utilize the exhaust of their gas engines just for this very purpose. The gases so formed in a producer by the complete combustion due to the air, and by the reduction of the carbonic gas and steam, meeting with no more air at the upper part of the fuel bed, can only burn in the cylinder of a gas engine, or at the orifice of the tuyeres in a furnace, after they have been mixed at these points with a proper proportion of air.

Let us now look into what actually takes place in an ordinary foundry cupola. In this case, the temperatures are much higher; there is no fear of destroying the linings here, or rather, it is a necessary and unavoidable evil, and the inconvenience of obstructions caused by clinkers is done away with by making the blast sufficiently powerful to either go through or around them. Moreover, the iron being a base and largely in excess as compared to the acid silica, the silicates produced are more fusible than those met with in gas producers; the temperature being also very high, these silicates run quite freely with the iron on to the sand bottom of the cupola. If necessary, this fusion is assisted by the addition of fluxes to the iron.

These scoria are particularly abundant in the neighborhood of the linings which they eat away and destroy quite rapidly. If the blast is a powerful one, the cold air coming in at the tuyeres, having a tendency to follow the line of least resistance, runs up along the sides of the cupola, cools them down around and above the tuyeres, and so sets or hardens the scoria coming down along the walls from the upper layers of the melting zone. From that time on, a rim of hardened scoria forms around the tuyeres and especially above them; this rim or cushion keeps on increasing in size, until it eventually stops the action of the cupola altogether.

If the cupola has only one run of tuyeres and the fuel is in small pieces, the action of the air upon the coal will be absolutely the same as in the producer; a great excess of carbon monoxide will be formed, and about two-thirds of the heat actually available in the coal or coke will go out through the stack without

having been turned to any use. If these gases were drawn off at the level of the charging door and sent into a gas engine, the hour-horse-power could be obtained from 160 cu. ft. of it. Now, as one pound of carbon, burned to carbon monoxide, yields 80 cu. ft. of gas, it can readily be seen that for every pound of coke or coal burnt, an extra half horse power hour could be produced and saved.

This is just what is now being often done in modern blast furnaces. In the case of cupolas, however, it cannot be done, and the loss and consequent waste of this heat is apparently beyond remedy. It is not the only loss made, either. The heat to melt the iron must be developed in any event, which means that 3¼ lbs. of coke must be burnt for every pound put to effective use. On the other hand, seeing that it takes only half as much air to burn carbon to CO as it does to burn it to CO_2, it will readily be understood that ½x3¼ or 1.60 volumes of air will have to be blown into the blast to transform the coke into carbon monoxide, as compared to one volume only required to burn the fuel to CO_2. This is an increase of 60% required in the supply of air, which means a corresponding increase in the power required to drive the blower, whenever combustion to CO is going on. This, of course, is an illustration of an extreme case, because it is impossible to make carbon monoxide alone, without making at the same time a certain proportion of carbonic gas.

This carbon monoxide may be seen burning as it passes the charging door where it finds the air required to burn it; or else, whenever the draft is weak, the gas not finding sufficient air in the stack, burns only at the top of it, where it spurts into a large sheet of flame, drawing protests from the neighbours, from the authorities and from the insurance companies. The above remarks are sufficient to show that the running of cupolas in this manner must be considered as an entirely unsatisfactory operation in every respect.

To secure more complete combustion, the blast is sometimes increased at an higher cost of power. If the fuel contains small pieces, and especially when it is coke alone that is being used, this remedy is not one at all and has no useful effect. If the coke is large, the air rushing more rapidly through the interstices, has no time to react as completely at the level of the tuyeres, there is

less formation of carbon monoxide, and the efficiency of the combustion is improved somewhat. But the slag is cooled down to a great extent by the incoming air, especially around the tuyeres, where it causes the formation of a cushion of solidified slag around and above them. Moreover the general result is to produce uneven temperatures causing oxidation of the iron and giving castings that are brittle and hard to work.

If large sized anthracite is being used, the reduction of the gases is still less rapid than with coke, and especially with light porous coke, because the surfaces exposed to the action of the air are much smaller in the case of the coal than in that of the porous coke. That is the reason why, in certain cupolas having only one row of tuyeres, better results will often be obtained with homogenous coal of sufficiently large size, or with a mixture of coke and coal, than could be secured with light coke, and better results too with a dense coke than with a porus quality.

Whenever the fuel contains small pieces, however, or if a porous coke is being used, it will become imperative to furnish an adequate supply of air to the upper part of the melting zone, in order to completely burn up the carbon monoxide which will be formed. With a properly located second row of tuyeres, it should always prove possible to do away completely with the combustible gases which generally ignite and burn at the level of the charging door, and so give unmistakable evidence of defective operation in the cupola. But how is it that, upon visiting cupolas fitted in this manner, it is generally found that after a certain number of fusions, the upper tuyeres have been put out of use in most cases? The reason is that it is an extremely difficult matter to place these tuyeres in the exact position they should occupy, and even then, to give them the proper dimensions. If they are made too large, they give an excess of air which is worse still than incomplete combustion of the fuel. The air has a tendency to go through these tuyeres in greater quantities than through the lower ones; the lower part of the melting zone cools down and the upper tuyers get clogged with slag which forms a circular cushion, projecting above them and finally grows in size, to the extent of separating the metal from the melting zone. The consequences of this are worse still than anything else.

The specific gravity or density of the fuel, its greater or lesser porousness and its average dimensions, will therefore all be important factors in the problem of determining the position of these tuyeres. It was shown just now how, in the case of uniformly large sized anthracite, a second row of tuyeres should actually be avoided. It is therefore impossible to make a fixed set of rules to govern the design of a universal cupola to suit any and all conditions.

A cupola, just like a producer, must be designed to meet the particular requirements of the fuel it is intended to burn, both as to quality and as to dimensions.

The difficulties besetting this problem would be greatly reduced if it were customary to proceed in the same manner for a cupola, as it is for a gas producer, viz., if a suitable proportion of steam or carbonic gas were blown into the fire at the same time as the air; by this means a constant temperature, not exceeding very much that of melted iron, could be maintained with comparative ease at the level of the lower tuyeres, regardless of the size of the fuel; a large amount of combustible gases would be generated by the dissociation of the steam and by the reduction of the carbonic gas, as well as by the combustion of the fuel with air; (hydrogen and carbon monoxide); then, a secondary supply of air coming in through the upper tuyeres would burn these gases back again into carbonic acid and steam, thereby developing a large amount of heat.

The entire melting zone would thus be kept at an even and constant temperature of say 2,000°, without any fear of its going any higher at any given point, where it might burn the iron and so deteriorate its quality and make it unfit for use. There would be no excess of cold air in any part of the zone and consequently, no tendency towards the formation of congealed slags around the tuyeres to narrow down the melting zone; the capacity of the cupola would only be limited by the resisting powers of its lining, which means that it would become from 10 to 20 times as large as that of cupolas blown with cold dry air. The complete disappearance of all slags blocking the tuyeres and interfering with the run of the cupola, would make operations extremely regular and sure; the volume and pressure of the blast could be reduced and a considerable economy realized in driving power for the blowers; the quantity of fuel per ton of iron turned out could also be reduced and, lastly, no flames would be seen either at the charging doors or at the top of the stack.

The conclusions to be drawn from the above are that the conditions most suitable for the proper operation of a cupola are the following:

1o. Distribute the blast through several rows of tuyeres, with a view to securing as complete and perfect a combustion as possible of the carbon and of the combustible gases; keeping an even temperature throughout the entire melting zone, taking care to make the cross section of the upper tuyeres much smaller than that of the lower ones, so as to avoid sending an excess of air into the upper strata of the melting zone.

2o. See that the position of these tuyeres varies according to the nature of the fuel, according to its degree of average humidity and according to its size, always bearing in mind, at the same time, that any fuel will always act with regard to the blast, in the same manner as if it were all composed of pieces of the smallest size it contains; also, that anthracite and dense cokes will have a deoxidising power considerable inferior to that of light porous cokes.

3o. It will always be advisable to mix in with the blast a stated amount of gases subject to being deoxidised by carbon at a high temperature, such as steam or carbonic gas. This will prevent the temperatures becoming excessive at points where the combustion is most active, and so preclude the possibility of burning the iron; it will also transfer any excess of heat existing around the lower row of tuyeres, to the upper strata of the melting zone, and in particular to that part of the fuel bed immediately in contact with the metal. As to the manner in which these auxiliary gases are to be procured, it is one of extreme simplicity, for all that is required is to draw them off from the upper part of the cupola itself, just beneath the level of the charging door where they are drawn off by means of an apparatus specially designed so as not to develop excessive temperatures in the blast piping. The result of this is to mix with the air of the blast, not only the carbonic gas resulting from the combustion of the coke and the steam coming from the humidity carried by the fuel, but also a portion of the carbon monoxide, which is just so much more fuel saved, as well as a certain amount of B. T. Us. furnished by the apparent heat of all the gases.

These processes and reactions were turned to practical use by Mr. A. Baillot, and so far, the results obtained by him, both in Europe and in America, in the various applications he has made of them, have been highly satisfactory. As much as ~~15~~ lbs. of 17 iron have been turned out per pound of coke, bed included, and the iron has always been found to be of quite a superior quality. In fact, Mr. Baillot has realised in actual practice all the desirable advantages enumerated above and, at the same time, secured greater speed of melting and increased capacity of cupolas for a given size than was heretofore possible.

AMERICAN FOUNDRYMEN'S ASSOCIATION

ANNEALING CASTINGS

By W. M. CARR, New York City.

Your esteemed secretary has asked me to make some remarks on the above mentioned subject. My compliance was given with a little hesitation because I have expressed my views on annealing at different times through the columns of the trade and technical press and a repetition of my researches at this time would not be novel or interesting. The object in presenting this paper is for the purpose of bringing out a discussion of the subject realizing that an interchange of views on an occasion like this will prove more beneficial to the foundrymen than a dry tabulation of records and figures in a formal paper.

Annealing methods in the foundry industry are recognized as established practices. No one will deny that in the malleable foundry annealing is a very important step. If there are in existence a diversity of opinions they do not conflict as to whether or not it is proper to anneal malleable castings. Whatever differences there may be hinge rather on methods. It is not fitting for me to present my views on the annealing of malleables or to discuss the effect of a heat treatment of hard iron. I cheerfully leave that subject and its intricacies to our friend, Dr. Moldenke, who has made a study of the matter and is fully competent to elaborate upon it.

In the manufacture of chilled cast-iron car wheels no dispute exists regarding their treatment in annealing pits. They would never be shipped or put into service without such treatment. The value of the treatment is fully recognized and receives as much attention and care as any step in their manufacture.

In the production of grey iron castings annealing is sometimes followed with a view to lessening certain stresses or strains set up in the cooling of the castings from the pouring temperature. The influence of the process in the case of grey iron upon the formation of the carbon compounds is not so important. If, however, changes should occur they would be in the direction of softening the surface of the castings.

In the three branches of the foundry industry just cited annealing is followed in the first instance primarily to change the

formation of the carbon compounds from a hard, glass-like carbide of iron to the temper carbon, a substance not unlike graphite in its characteristics, conferring softness and malleability by certain methods of heat treatment upon a previously hard, brittle substance. In the second case, annealing lessens intense cooling strains in the plate and other parts of the wheel but does not so affect the carbon compounds as to damage the depth and hardness of the chilled tread, throat and flange. In the third instance annealing concerns mainly the avoidance of cooling strains.

Coming to the steel casting industry we have a very important one in which annealing is open to some doubt. It may be the practice or it may not. That it has some value is a settled fact but is not generally so recognized. When specifications so demand steel castings are put through an annealing furnace, frequently without any consideration as to the conditions of time and temperature. In the absence of annealing specifications steel castings are frequently shipped without such treatment.

Here we have the paradox of pains taken in the selection of raw materials, watchful manipulation of the melting and refining process in converting pig-iron and steel scrap of proper quality into steel, pouring it into molds of particularly refactory sand, stripping and cleaning followed by rigid inspection for flaws and imperfections outwardly visible and finally shipping to customer without annealing, delivering the castings with unknown stresses present, course, internal structure and other variables more or less liable to vitiate the value of the castings in service. If a casting shipped under such conditions should fail in service, all the precautions thrown around the methods of treating the raw material entering into it are wasted. The casting may be smooth, solid, true to pattern, of the proper chemical composition and the test bars examined from the same heat of steel meet standard specifications in tensile strength, etc., still with all apparent evidences in its favor, if it is not annealed before going into service there will always remain a doubt as to the life of usefulness. The casting may fail unexpectedly. I do not mean to say that annealing will make the casting infallible but I do know with other conditions being equal that an annealed casting is less liable to fail in service than one not annealed. Surely then on the ground of consistency, in the light of modern methods, taking due consideration of all the preliminary operations leading

up to the finished casting and eventually ignoring or slighting the final step of annealing, the step is of enough importance to demand proper attention.

In annealing steel castings we have conditions that are not entirely comparable with conditions existing in other branches of the foundry industry where annealing is more or less essential. The operation is not concerned with the changes in the carbon compounds. That is to say the same carbide of iron will be present both before and after the treatment. In the matter of internal structures there are mainly two components, first, the crystalline formation and its refinement resulting from proper thermal treatment, and secondly the removal or lessening of internal stresses set up in cooling down from the casting temperature. It is peculiar to most metals that they should crystalize when cooling from a temperature at which they are cast and the size of the crystals vary with the temperature and rate of cooling. The size and formation of the crystals have a decided influence upon the physical properties of the castings. Upon reheating metals to what is known as a refining or annealing temperature the grain or crystals of the metal will become smaller than their original form and with the change in structure will come better conditions physically. The castings will be tougher and better fitted to accomplish the work for which they may be designed. The refining temperatures are not the same for all metals but generally speaking a suitable temperature to grain refine cast steel is about 825 to 850 degrees centigrade.

There are however practical considerations to take into account that cannot be determined entirely by laboratory tests, such as the length of time to anneal a casting of a given shape and size, the style and type of furnace best suited to certain requirements. These points are capable of determination through the character of the product and the probable tonnage.

CORE MAKING

By ARCHIE M. LOUDON, Elmira, N. Y.

Core making is one of the most important parts of the art of founding, and yet for some little understood reason, the getting of proper results is left to chance in a great measure. The core room should be familiar to every molder just as much as his floor, but he dreads it very much as it would seem.

In going over this field in my mind I have concluded to embrace the opportunity at the present time, and start a little discussion on the subject. I do this in the hope that our foundrymen will come out and talk on the matter, giving their experience with materials and methods, so that more light may be shed upon the difficulties attending the making of important cores, and how these difficulties may be overcome.

Here is my experience with a variety of cores:

1. Radiator cores. These are safest and best made of bank or beach sand mixed with oil in proportion of one part oil to forty to sixty parts sand. Bake quickly until well browned. The result will be easily vented cores, and a ready extraction from the casting. This is important, as the work must be entirely clear of the core before testing.

2. Steam and Water Boiler cored castings. Use bank or beach sand with about 25% mash. Or, add floor sand to make the core stronger without having to use too much oil. The addition of oil is a particular matter and not readily controlled, for with too much oil the cores are more difficult to bake and become so hard that portions are left inside the castings, causing serious damage at times when these castings are used. The old sand helps the binding of the sharp sand, and as the castings are usually three eighths of an inch thick, the oil is completely burned out, and the material easily extracted. The mixture best suited to this class of work is 75% sharp sand, and 25% old

floor sand. Then take one part of oil to fifty to sixty of the sand mixture.

3. Small cores for general use, which have to be kept in stock. These are safest when made of the mixture for radiator cores, if the castings are to be light or medium in weight. Small cores for heavy castings should be made from a good strong fire sand and molding sand with a somewhat refactory binder such as flour and graphite. This is necessary to get a good clear hole in the casting.

4. Small cylinder cores should be made from an oil sand mixture. Similarly the barrel core, as there is less liability of blow holes from such cores than from any others known in the art. Further, when the iron is machined a clean smooth surface is left for the tool. The iron is also liable to remain softer. Hence this mixture should be used for port cores, exhaust and steam chest cores. Use straight beach sand and oil, in proportion of one oil to forty to sixty parts sand.

For barrel cores about 20% coarse molding sand mixed with 80% beach sand, with oil one to fifty of the sand makes an excellent open core. Use this on cylinders up to 10" diameter. When the section of the casting becomes heavier a stronger mixture is necessary.

5. Large cylinders necessitate a strong but open mixture to have the results good. Fire sand, molding sand, sharp sand, each one third. Mix with glue water, two lbs. glue in three gallons of water, the solution brought up to the boiling point only. This glue water to 100 lbs. of the sand mixture. Dampen the sand with additional water, it being understood that this is for large cylinder cores for immediate use, as well as dried molds in one form or other. The reason for using glue is that in this way we get the difficulty from gases down to a minimum. This mixture will care for all cores in cylinders with perfect reliability.

6. Large cores used for a variety of routine work must be made by the foundryman with the different sands and binders he has, and the mixtures varied to suit his needs. A variety of formulae will give equally good results. My preference is as follows: For ordinary cores, one third coarse molding sand, one third beach sand, and one third old sand. Mix these and take

one part Syracuse dry compound with thirty six of the sand mixture.

Where the large cores should be strong, use one third coarse molding sand, one third fire sand, and one third old sand, and for each thirty six parts of the mixed sand use one part Syracuse dry compound, and one half part flour. I mention this particular binder as it gives me the best results with the sands peculiar to my locality. Other binders, both liquid and dry will go equally as well with the sands they are specially suited for.

I trust in the discussion to follow, that those present will give their own mixtures and experiences, so that all may learn from what is brought out.

AMERICAN FOUNDRYMEN'S ASSOCIATION

FOUNDRY WAREHOUSE METHODS

By F. C. EVERITT, Trenton, N. J.

With possibly a few exceptions, probably no one subject which we might classify under the heading of "System" would be subjected to a wider range of variation, due to the local conditions of various Plants and their line of goods manufactured, than the subject of "Foundry Warehouse Methods." To carefully consider and present any one plan or method that might be generally applied for the proper and profitable handling of goods and that the majority of Manufacturers would not raise objections to if applied to their particular case, would be very exceptional. Not that they would be averse to the application of such methods; but because the conditions are so varied that radical changes in any set method when applied to different Plants are absolutely necessary. It is very true that the local conditions can be changed to conform with the method in question, but this is not always advisable as it might involve a greater expense and more confusion than could be over come in a long time, whereas, a few changes in the methods to be adopted would give entire satisfaction with little expense.

In submitting any method, it will be necessary to confine ourselves to those Plants which conduct a Warehouse in connection with a Foundry and Mounting or Finishing Departments, and then only as a suggestion that may be the means of provoking discussion and bring to the attention of our members the success with which other methods have been and are being applied by Firms conducting well organized Warehouses.

For convenience we will consider a Plant operating a Foundry, a Mounting or Finishing Department and a Warehouse. We will assume also that the Plant has been in operation for a given period. This will provide us with some knowledge as to the demand for the different articles manufactured. We may then decide what points are most important for careful consideration before applying our method.

(a) Method of storing the finished stock in the Warehouse. Its location and records.

(b) Method of ordering completed goods for Warehouse stock.

(c) Means of ascertaining quantities sold in the past in order to judge what quantities to order for stock, preventing an overstock and guarding against the article becoming obsolete before stock is exhausted.

(d) Method of handling orders for shipment which might be held for shipping instructions. Location of these prepared orders.

(e) The storage and handling of castings before mounting and the method of ordering on the Foundry.

With the first item (a) it will be necessary, according to the construction of the Warehouse, to carefully and systematically arrange the different floors into sections or bins as the case may suggest, the floors, sections and bins being numbered in the order named, i. e., floor No. 1, section 25, bin 50. We can then very readily refer to the location in a simple manner (location 1, 25, 50). This is a very simple outlay and one which is undoubtedly used by many Manufacturers. With this part of our plan established we may prepare the Warehouse Office "Stock and Order Book," a sample sheet of which is shown (Fig. 1). On these sheets, bound in loose leaf binders, we will enter the name of the article and its size, maximum and minimum quantities to be carried in stock and its location. (One sheet or page being used for a single article). As the orders are received in the General Office and recorded, copies are sent to the Warehouse Office and entered immediately on the Stock Order Book in the columns under the heading "Orders." The stock on hand having been previously entered in the "Stock" column, we readily note that we have 300 on hand and can ship at once. A Warehouse Memo Slip, bearing the order number, customer's name, article and its location, is handed to the man in charge of the stock to prepare the goods for shipment, after which he reports to the Warehouse Office, goods ready to ship. When shipped the ticket or original order is again referred to the Stock Order Clerk, who enters the shipment in "Shipped" column, and the balance on hand reckoned and enterd in "Stock" column.

(b) As the stock falls below the minimum quantity, a requisition is at once issued on the Mounting or Finishing Dept. As the goods are received from this Department, a daily report is made by the Warehouse man to the Stock Order Clerk, who makes the proper entries in the "received" column, the quantity in each case being carried to "Stock" column and showing a total.

(c) If this method be continued for a period of one or two years it is very plain to see that we will have a volume of valuable information that can be applied to a good advantage. We are able to tell at all times the number of orders on hand for any

Fig. 1.

ARTICLE Nameless Artic

Max. 800 Min. 250

	ORDERS.			
	Date.	Order No.	Customer.	Quan.
	4-1-08	2561	Jones & Co	100
	4-14-08	2843	Smith & Son	125
	4-16-08	3001	Brown & Co	200

Fig 2. ARTICLE

PLATE NO.

		ORDERS.		
	Due.	Date.	Order No.	Cust

Fig 3. STOCK.

	Location.	ARTICLE.

article Size #1

Location of Stock Floor

Quan.	SHIPPED. Date.	Quan.	REQUISITION FOR STOCK. Date.	Req'n No.	Quan.	RECEIVED. Date.	Quan.
100	4-2-08	100					
125	4-14-08	125	4-2-08	480	500	4-3-08	25
						4-4-08	50
200						4-8-08	200
						4-13-08	225

RDERS. Customer.	Quan.	SHIPMENTS. Date.	Order No.	Dept.

RTICLE.	ORDERS ISSUED. Date	Order No.	Qua

XI

SHEET NO.

Total Shipped 1907 2000

" " 190

" " 190

Bin " " 19

	APPLIED ON ORDERS.			STOCK.			
an.	Date.	Order No.	Quan.	Date.	Required.	On Hand.	
				4.1.08	100	300	
5		Stock		4.2.08		200	
0		"		4.4.08			
0		"		4.8.08			
5		"		4.13.08			
				4.14.08	125		
				4.15.08		575	
				4.16.08	200		

Total Shipped 19

" " 19

" " 19

" " 19

S.		
Dept.	Quan.	REMARKS.

MAX. MIN. YEAR.

	PUT IN.		TAKEN OUT.		ON HAND.	
Quan.	Date.	Quan.	Date.	Quan.	Date.	Quan.

XUM

one article, requisitions issued for goods to go in stock, quantities received, stock on hand and the quantities sold for the above mentioned period, the last item of which will enable us to intelligently fix the maximum and to know what quantities to order for stock to meet future demands. In placing these requisitions for stock on the Departments we must not lose sight of one important fact, i. e., do we know or are we in any position to tell, with the above information at hand, whether the demand for any one article will be as great during the year to come as was the case with the year just past. We do not, for while the outlook for the next year's business may be unusually favorable, we may have discovered by referring to our records of two or three years that size No. 1 of a given article sold during one year at the rate of 2000 and size No. 2 sold at the rate of 500. Another year has shown that No. 1 decreased and No. 2 increased in sales, which might have again reversed during a third year. If we have placed our maximum during the last year at 2000 and wish to place a requisition on the Mounting or Finishing Department for a six month's stock, we must endeavor to keep the stock within salable quantities and the conclusion is simply a matter of "Good Judgment" and we decide that a six months' stock order will be 700 instead of 1000 which will, according to our best judgment, prevent an over stock and keep it within the danger line of decreased business.

What conclusions are we now able to draw from the above information? Simply this, that we have data at hand which will serve as a guide in preventing an undesirable over stock that so often results in an accumulation of goods that really become dead and obsolete. We cannot say, however, that the method would entirely obliterate this undesirability, but it would tend to minimize these possibilities which would be a big step in the right direction.

(d) Returning again to our Stock Order Book, we must endeavor to avoid all confusion in order that our records be simple and accurate. With this in mind we will take for example goods reported for shipment and held pending shipping instructions. The goods must be placed in a located section of the Warehouse nearest the Shipping Floor, this location having been noted on the Warehouse Memo before being reported to the Stock Order Clerk. We will note in the "Order" Column of the sample sheet an order for Brown & Co., 200 articles and in the "Stock" column, required, 200 with no balance made and no entry having been made of shipment. This will show at a glance that the goods on this order are being held and the memo on file will give the location of the order ready for shipment. If this precaution is not taken and the entries and balances made when goods are reported, we will have a false statement of stock on hand as well

as being in a position to over look these prepared orders when taking inventory from the Stock Books at the end of the year.

The method as outlined above has been made as general as possible under the conditions mentioned and we might add that where the articles named are completed as one, the method is simple and easily handled. However, if the articles are composed of many parts, any one of which might form a part of several other articles, it might be wise to rely on a second method briefly outlined below. This method can be applied to good advantage in the Departments where the many parts are used to make the assembled article and in conjunction with the Warehouse Stock Order Book.

While this record (See sample sheet, Fig. 2.) may seem a duplication of the Warehouse record and apparently call for unnecessary clerical work, it serves to a very great advantage in the Department in as much as it shows at all times an accurate record of the requisitions on file for goods to be made up for Warehouse Stock and orders from other Departments that may be in the Plant. The two methods worked together would undoubtedly be subject to many changes due entirely to the size of the Plant, the number of Departments and the general disposition of the goods manufactured.

(e) The forms shown Fig 2 and Fig 3 are intended to be used in the same Department but are to be handled entirely independent of one another; Fig 2 being a record of orders and shipments and Fig 3 a stock record of castings and a record of orders issued on the Foundry. This form is simple and needs little explanation. The method of locating the stock would, of course, be the same as outlined for the Ware House and a single sheet or page in this book used for each casting. Ample space is allowed for the name and description of the part, as well as a rough sketch if desired. The maximum and minimum quantities to be carried in stock can be ascertained precisely as in the first method. The columns for orders issued on the Foundry, date and quantities received, taken out and on hand are simple and need no further explanation.

The two methods here outlined worked in conjunction or separately may fulfill all requirements, but will without a doubt be subject to the changes found necessary in various Plants owing to the variety of local conditions.

AMERICAN FOUNDRYMEN'S ASSOCIATION

THE PREVENTION OF ACCIDENTS in the FOUNDRY

By THOMAS D. WEST, Sharpsville, Pa.

Probably the factor of greatest potency in the reduction if not entire prevention of acidents in the foundry, is the requirement that the persons in charge possess a cautious and earnest disposition, are thorough and painstaking, and have a just consideration for the welfare of those over whom they are placed.

To detail the causes that make toward accidents in our foundries requires quite a catalogue. We may mention the following: Indolence, smoking and drinking, forwardness, stupidity, rashness, deliberate carelessness, independence of orders, callousness regarding the safety of others, or perhaps deliberate trickery or spite. This more on the part of the operatives. Next mismanagement, disorder, tyranny more particularly in the overseers, and absence of safety devices and intelligent controll of the works on the part of the management. The latter items go to the account of the owners.

Some foremen and sub-foremen have the faculty of doing everything with precaution as to accidents. Others seem to think that it is not their affair, and when something does happen, put the blame on some one else. Here is a case that will illustrate one phase of the problem: The writer once took occasion, in placing an experienced molder in charge of the green sand department of a large foundry, to watch him closely regarding his work particularly in preventing accidents. The man, as many others of his class, had never had the opportunity to train himself to meet the responsibilities of caring for life and property. For that reason every opportunity was taken to impress him on this score. One day, noticing him pour a very thick open sand casting, and having this covered thickly with sand, I instructed him to place a careful man by the side of this casting to keep any one from walking into it. An expression of surprise came

over his face and he said "Mr. West, I have been in the foundry for forty years, but this the first time I ever heard such an order given." It was my opportunity, and ever after that this foreman needed little if any reminding that he was expected to look after life and property just as much as getting out tonnage. This principle I labor to impress on every one who comes under my care.

Another point which prevents men in charge from exercising all possible precautions is the lack of credit they get for this from higher up. Thus to see that nothing but a good bolt or a sound and annealed chain is used. That the "temper" of the sand is watched, the ramming, venting, coreing, clamping, and the other manipulations incident to the foundry are carefully attended to as they should be. To notice that the ladles are dry, and that no one sticks wet rods or skimmers into the metal, or spills water over the gangways and around the cupola. All these things are little, but they are factors the neglect of which may cause serious accidents at any time. It is difficult to tax a particular person with these preventable things as it always makes bad blood and increases the difficulty of proper management.

When proprietors upon a time were all practical molders, the prevention of accidents was much more carefully looked after than is now the case. Nevertheless, the situation can be much improved by recognition on the part of the management of those foremen and other overseers who give this matter their careful and special attention.

The installation of safety devices, much as they are needed and should be used wherever required, should not, however, cause the abandonment of all precautions, or their absence serve as an excuse for neglect. The tendency of lazy or careless individuals is to obstruct any attempt to rouse them from these habits, and hence in watching and improving the shop organization, these matters should be borne in mind, and careless men let out.

There is much to be said on the subject of Accidents, their cause and remedy, and I would respectfully suggest that the American Foundrymen's Association look into this matter more closely. To appoint a committee to cooperate with other organizations looking toward the prevention of accidents in our foundries and other industrial establishments, thus adding to the sum of our National prosperity and life and health of its citizens.

AMERICAN FOUNDRYMEN'S ASSOCIATION

SPECIFICATIONS FOR CAST IRON TO BE MACHINED

By H. E. DILLER, Chicago, Ill.

The machine shop which buys its castings generally takes what it gets—soft, medium, or hard—and usually has no redress, unless the satisfaction of constant complaint and frequent change of supplier may be called this. General complaint seems to be the only remedy the machine shop which purchases its castings feels willing or able to make. Although many companies specify that out of each heat, one or more test bars shall be cast and tested, this is usually done to insure strength but not softness in the iron. Now there are a great multitude of castings on which considerable machine work is done and for which the strength of any soft iron is sufficient. For this class of castings, I would propose a specification which need cover only two points as to physical qualities and two points in the composition of the iron, and still insure a satisfactory casting.

First, that the castings be free from blow and shrink holes. This is the only qualification the majority of castings require to insure sufficient strength.

Second, that the surface of the casting be smooth and reasonably free from sand. This is a rather indefinite statement, but by establishing a standard of work between the individual buyer and producer, the specification can be made to mean something. Then the two specifications which I would suggest for the composition of the iron, are upper limits for the amount of combined carbon and the amount of sulphur.

It would also be advisable to have a standard method for determining the amount of combined carbon. By using the color method and having the same standard, there is no reason why there should be any dispute as to whether the castings were coming up to requirements.

With such specifications, the foundry could be made to stand the extra expense of machining hard iron, and the foundry which

could make regularly soft castings could command a higher price for them. When it is considered that the extra cost of machining a very hard casting sometimes equals the cost of the casting, it seems fair that the man who makes the hard casting should have some handicap in competing with the foundryman who turns out a uniform grade of iron.

As to the reliability of the combined carbon as an indicator of the hardness of the iron, I was convinced by nearly a year of daily tests on a drill press and color carbon tests. These tests usually agreed closely, but when they did not, it was invariably due to some irregularity in the way the drill was sharpened or a little less power in the drill press.

It might be advisable to put an upper limit on the amount of phosphorus, but this limit would be so high as to be practically no limit—say one per cent.

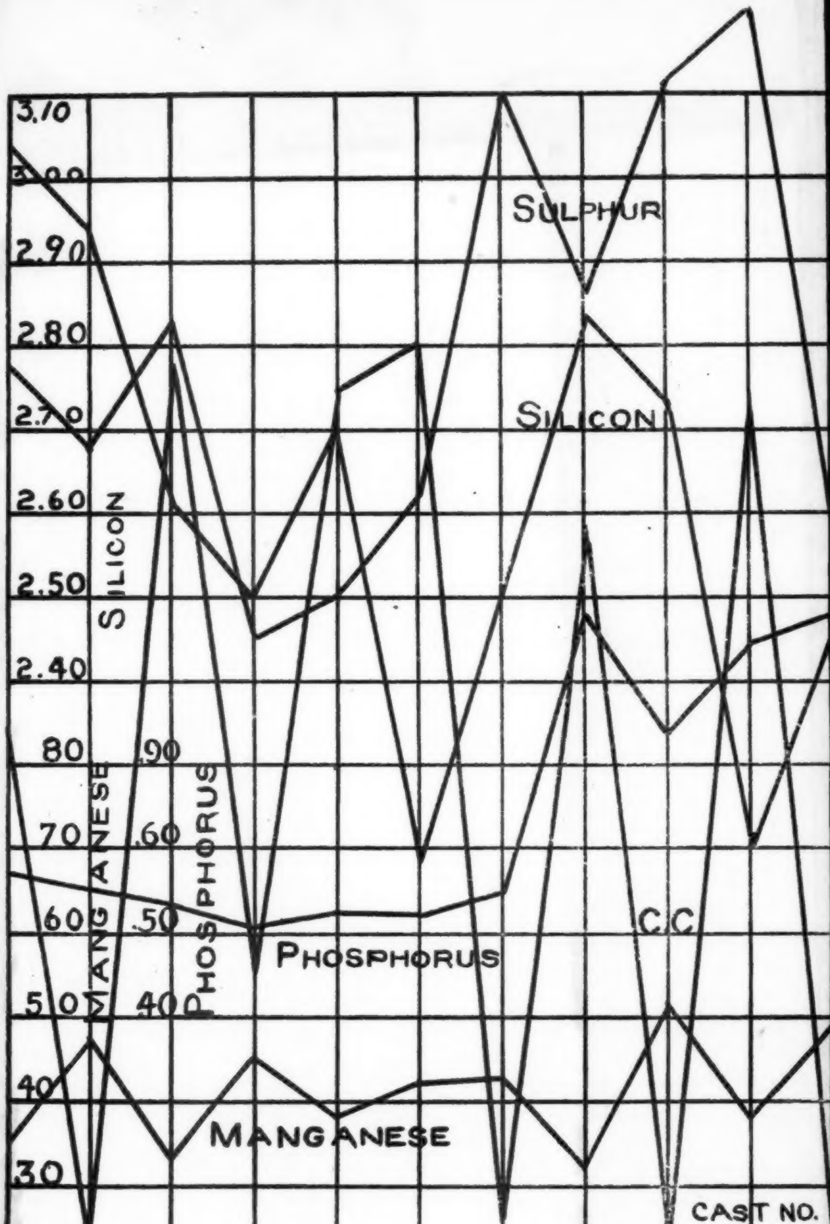
There are so many variables entering into the making and composition of a casting that to me it seems the only and simplest way of specifying the quality of the iron for machining is to require it to be free from physical defects and to set a limit on the amount of combined carbon it may contain.

The accompanying chart gives a graphical illustration of the effect of manganese at the critical point on a fairly high silicon iron, cast in a heavy section to avoid the effects of the mold on the cooling of the iron.

Chart No. 2 gives only the manganese and carbon curves.

On chart No. 1 we see for the eighth cast, with the silicon nearly the highest of any cast—2.83%—and the sulphur medium —.091%—the combined carbon was high—.86%—while in the second cast in which the silicon and sulphur are about the same as in the eighth cast—2.94% and .073%—the combined carbon is only .04%. Again taking the ninth cast with sulphur much higher—.117 and silicon a little lower—2.73%—which should make a harder iron than that in the eighth cast, we find only .04% of carbon. Now let us note that in the hard iron, the manganese is .32% while in the soft iron it is .47% and .51% respectively.

From this chart, it would seem clear that silicon and sulphur contents will by no means guarantee a soft casting, even in a heavy section, if other conditions are not right; but that a determination of the combined carbon will tell very quickly if the iron is hard.


3.10
3.00
2.90
2.80
2.70
2.60
2.50
2.40
80
70
60
.50
40
30
.90
.60
.50
.40
SILICON
MANGANESE
PHOSPHORUS
SULPHUR
SILICON
PHOSPHORUS
CC
MANGANESE
CAST NO.
1
2
3
4
5
6
7
8
9
10

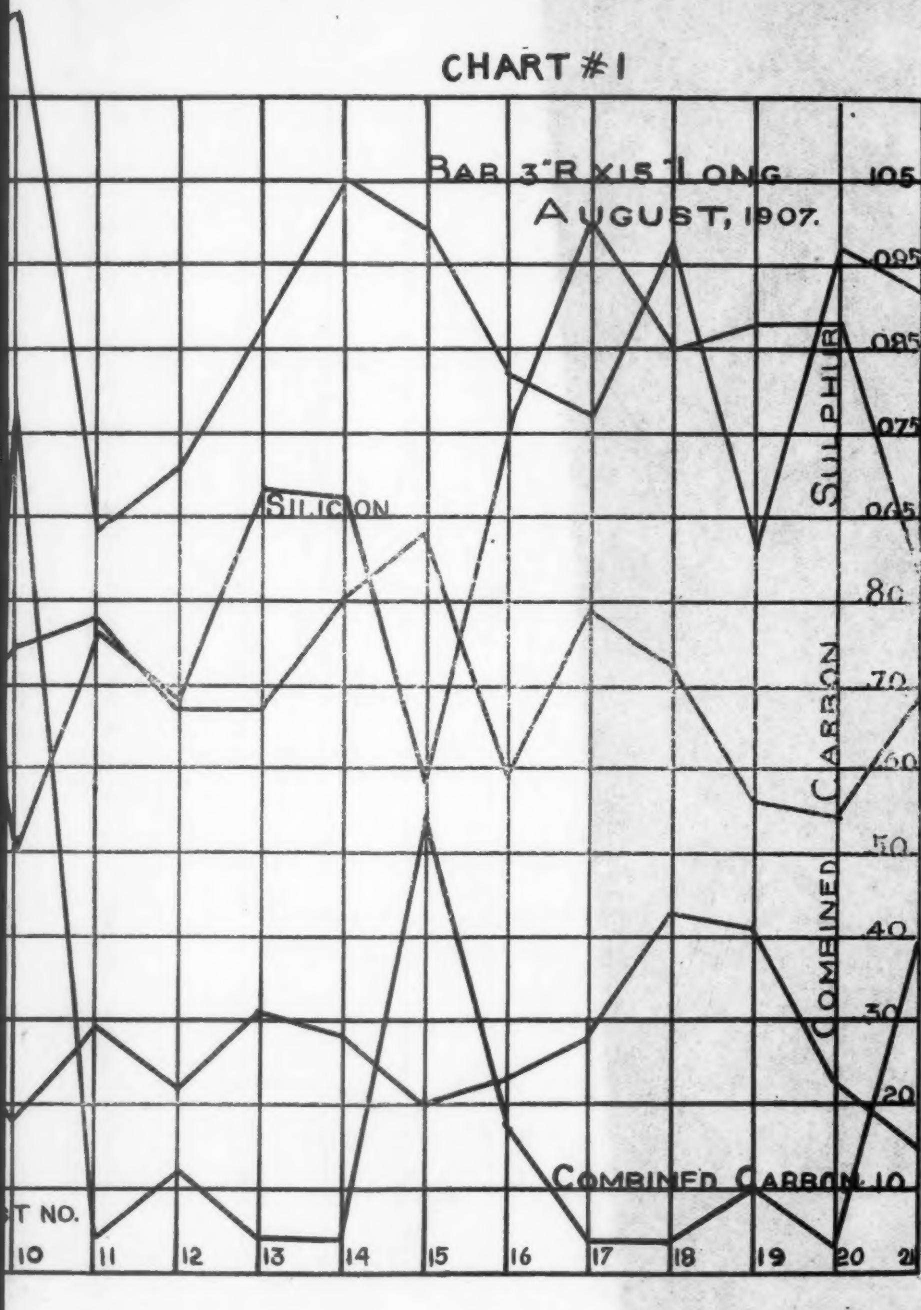
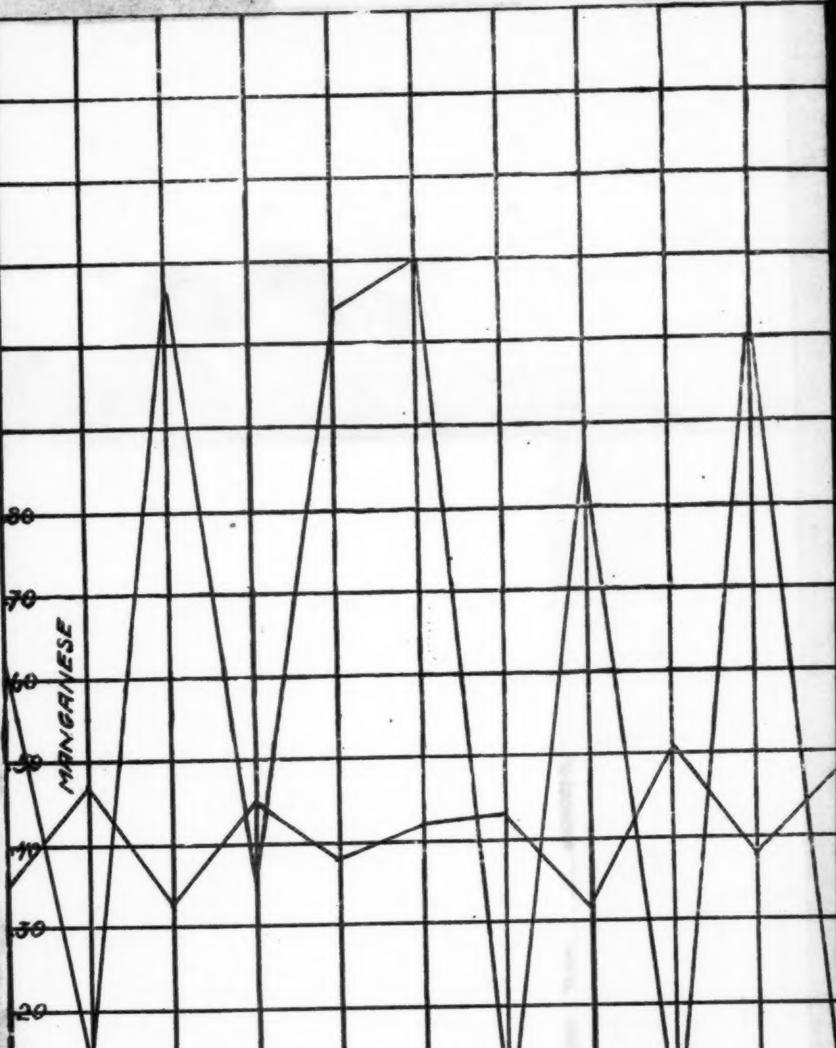
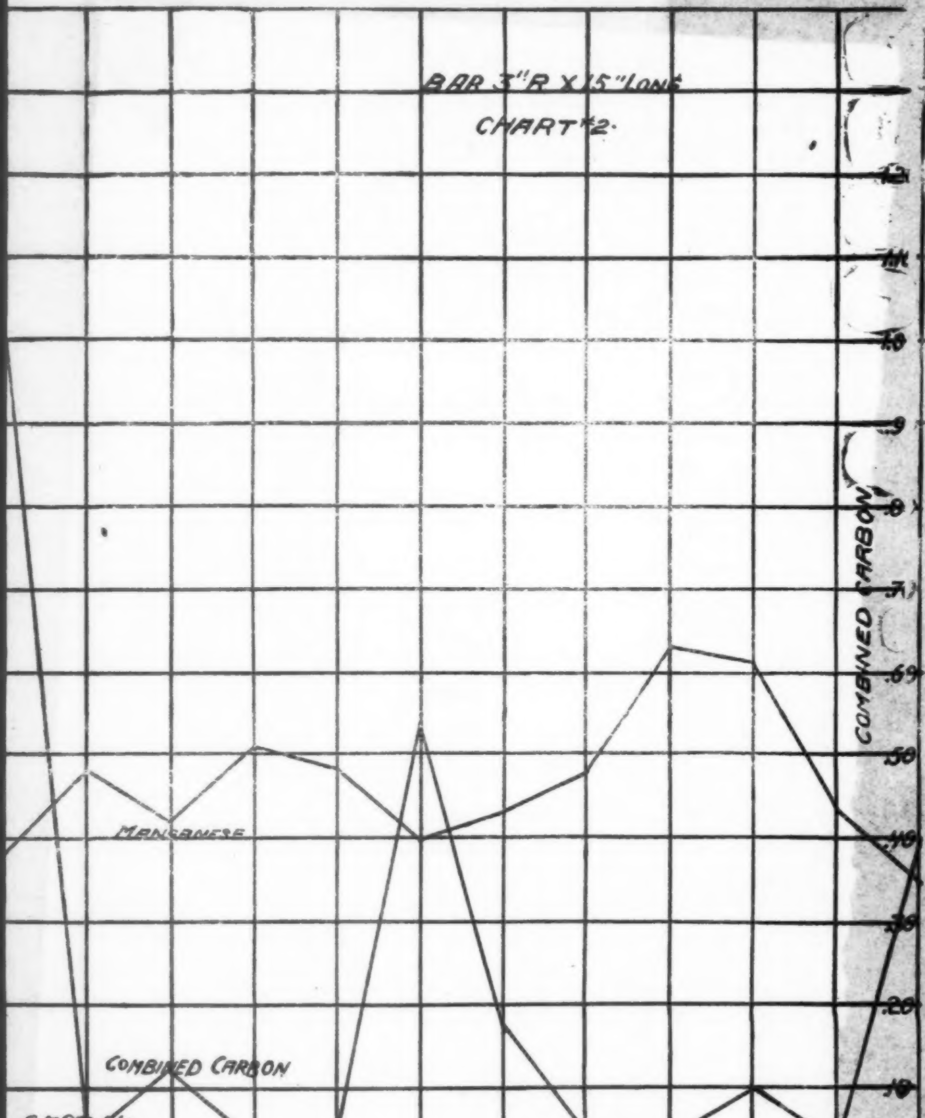


CHART #1
BAR 3" R x 15" LONG
AUGUST, 1907.
SILICON
SULPHUR
COMBINED CARBON
COMBINED CARBON
105
.095
.085
.075
.065
.80
.70
.60
.50
.40
.30
.20
.10
T NO.
10
11
12
13
14
15
16
17
18
19
20
21

No 285


MANGANESE
80
70
60
50
40
30
20
10
1
2
3
4
5
6
7
8
9
10
CAST



BAR 3" R X 15" LONG
CHART #2.
MANGANESE
COMBINED CARBON
COMBINED CARBON
CAST No.
10
11
12
13
14
15
16
17
18
19
20
21
.10
.20
.30
.40
.50
.60
.70
.8
.9
1.0
1.1
1.2

AMERICAN FOUNDRYMEN'S ASSOCIATION

FERRO-ALLOYS IN THE FOUNDRY

By W. M. SAUNDERS, Providence, R. I.

The manufacturer of steel has found the addition of certain metals to endow the steel with properties it did not before possess.

The foundry metallurgist, observing this valuable addition to steel, naturally turned to the same metals for improving cast iron.

For many years the high cost prevented a very extensive use of these metals. Within a few years improvements in methods of manufacture, due in part to the progress made in the use of the electrical furnace, or the discovery of new deposits of ore in more accessible localities, have lowered the price. At the present quotations, with few exceptions, the cost prohibits the use of these metals very extensively, except in special cases where castings are required demanding unusual qualities.

Most of the metals employed melt at a higher temperature than cast iron, and consequently do not react to the best advantage with the iron. This difficulty has been overcome by first making an alloy of iron and the metal, which melts at a lower temperature and easily diffuses throughout the cast iron.

The manufacture of ferro-alloys claims an important place in modern industry, and the electrical production has increased until it is one of considerable value.

MANGANESE. The importance of manganese to the steel maker cannot be readily estimated. When Bessemer in working out the process for making steel, utilized the discovery of Mushet, that ferro-manganese added at a certain step in the operation produced a sound commercial steel, he not only perfected the manufacture of steel, but placed manganese as one of the most important and necessary metals in that industry.

The ferro-manganese known as spiegeleisen, used at that time contained from 10 to 15 per cent. of manganese, and was made

in the blast-furnace. Today ferro-manganese can be obtained containing 80 to 85 per cent. manganese.

Some years ago, about 1886, Mr. R. A. Hadfield discovered that steel with one and one-half per cent. manganese became brittle. Between 5 and 7 per cent. manganese it became very brittle. With the addition of manganese above this amount, the steel began to lose the property of brittleness, and assumed that of toughness and hardness. These qualities greatly increased in the presence of a certain amount of carbon and the proper heat treatment, until the steel contained about 12 per cent. manganese, when it became exceedingly tough and hard. This material was known as Hadfield steel.

The effect of manganese upon cast iron resembles in many ways that upon steel.

High manganese castings are employed only in special cases where exceptional hardness is desired. Castings with one, to one and one-half per cent. manganese are sometimes made, but the best results are obtained in gray iron with manganese under one per cent.

Ferro-manganese in the foundry has an important part to play in perfecting cast iron. It has been claimed that ferro-manganese makes hard iron soft, and soft iron hard. This anomaly is not difficult to explain. Cast iron with a low percentage of manganese often gives trouble in machining, by causing the drills or tools to become dull. This trouble at once disappears upon adding enough ferro-manganese to bring the manganese to 0.5 per cent. High manganese pig iron added to the charge in the cupola will also give the same result.

Manganese reduces the tendency of cast iron to chill, and consequently when ferro-manganese is added in small quantities in the ladle, the iron becomes softened. Advantage is taken of this fact by car wheel makers who add a small amount of ferro-manganese to the molten iron just before casting and thus improve the strength and endurance of the wheel.

Ferro-manganese hardens cast iron by increasing the percentage of manganese. A cast iron may contain the requisite amount of manganese for good machining, but it is necessary to make the iron hard and tough for cylinder purposes. With the addition of enough ferro-manganese to raise the manganese to one percent. or over, the desired hardness is produced.

Ferro-manganese removes sulphur from cast iron by forming a compound of sulphur and manganese which rises to the surface as slag, but only when the iron is very hot. It is also beneficial in removing oxides from the iron. The manganese seizing the oxygen combined with the iron, forming manganese oxide which rises to the surface of the molten metal and passes off as slag.

SILICON. Ferro-silicon containing silicon up to 20 percent. is a product of the blast furnace, and is extensively used in the foundry as a "softener." With the event of the electrical furnace ferro-silicon containing as high as 75 percent. silicon became possible. That having 50 percent. silicon is probably the most desirable to use in the iron foundry, on account of its lower melting point.

Ferro-silicon is used in steel making as a deoxidizer.

Steel containing a small amount of silicon, was at one time considered undesirable where strength was important. It has now been proved that a small percentage of silicon in a steel greatly increases the elastie limit and tenacity. A further addition causes the steel to become weak, until at about 4 percent. silicon it is very brittle and hard.

Cast iron with 4 percent. silicon also shows weakness, but not as marked as in steel. As the silicon in cast iron increases above 4 percent. the hardness and brittleness becomes very apparent.

Ferro-silicon melted in a cupola with cast iron in the right amount, tends to soften the iron and reduce strength. Mr. A. E. Outerbridge, Jr., found the addition of a high grade ferro-silicon (about 50 percent. silicon) to the molten iron in a ladle, not only softened the iron but increased the strength from 15 to 25 percent., as shown in transverse test bars.

Overheated iron in an air furnace often may be restored to the right condition upon adding a sufficient amount of ferro-silicon; the silicon deoxidizing the iron, leaving it in the proper state for good casting.

Silico-manganese, containing from 35 to 70 percent. of manganese, and 20 to 25 percent. silicon, the remainder chiefly iron, is sometimes used to raise both the silicon and manganese in cast iron; its action being similar to a mixture of ferro-silicon and ferro-manganese. In steel making it is employed as a deoxidizer.

Carbide of silicon, containing about 60 percent. silicon and

30 percent. carbon, is occasionally used in steel making as a deoxidizing agent. In the foundry it is not generally employed on account of its high melting point, but when used is charged in form of lumps with the pig iron in the cupola. The effect of carbide of silicon is to increase the silicon, and carbon to some extent.

ALUMINUM. Aluminum is used in the manufacture of steel for the purpose of assisting in the formation of sound ingots; little or none of the metal entering into the composition of the product. When an increased amount of aluminum is added, a part alloys with the steel and the effect in small amounts is similar to that of silicon. Either the metal or ferro-aluminum containing 5 to 20 percent. aluminum may be employed.

In cast iron the influence of aluminum resembles in many ways that of silicon. A white cast iron to which one-half to one percent. aluminum has been added, assumes at once the appearance of gray iron.

In 1890 Mr. W. J. Keep published the results of his experiments upon the addition of aluminum to cast iron. He found the addition of aluminum increased the proportion of graphitic carbon, and the softening of the iron increased up to 4 percent. Aluminum added in large amounts reduces the total carbon by throwing out the graphite. Aluminum diminishes the tendency of cast iron to chill; it also reduces shrinkage and increases strength when in small amounts. Above 4 percent. aluminum the softening influence begins to diminish, and the strength of the iron to become less, until cast iron with 12 to 14 percent. aluminum is very weak.

PHOSPHORUS. Ferro-phosphorus is made containing from 20 to 25 percent. phosphorus. In steel making it is used to increase the phosphorus in basic slag for certain purposes, and also to add phosphorus to steel used in making thin rolled plates.

In the foundry ferro-phosphorus is employed to increase the phosphorus in cast iron in the ladle, when it is desired to prolong the time of fluidity, as in the case of very thin castings.

Cast iron containing about one and one-half percent. phosphorus causes the tools used in machining it to become heated and quickly worn, while with 2 percent. and over, cast iron becomes brittle and weak.

Phosphorus under one percent. in general machinery castings

is desirable, and in some cases as low as 0.2 percent. is necessary to secure strong iron.

TITANIUM. Ferro-titanium is made containing 10 to 30 percent. titanium.

In the form of ferro-alloy, and also as titanium thermit, titanium is used in small amounts in steel making and in the iron foundry to remove gases absorbed by the molten metal. The action is purely chemical, the titanium combining with oxygen forming oxides, and with nitrogen forming nitrides of titanium, the resulting compounds being found in the slag; none of the titanium entering into the iron, which remains soft. With larger additions of the alloy, a small percentage of titanium unites with the iron tending to harden it.

Whether the action of titanium is direct by alloying with the iron, or indirect by the removal of gases, the results show marked improvement in the iron. Test bars made from cast iron to which 1 to 5 percent. of ferro-titanium (containing 10 to 12 percent. titanium) had been added, showed an increased transverse strength up to 40 percent. over bars made from iron receiving no titanium.

VANADIUM. Ferro-vanadium can be obtained containing from 10 to 50 percent. vanadium. Small amounts of vanadium added to steel, not only increases the tensile strength without making the steel hard, but prolongs its ability to withstand shocks and fatigue. One action of vanadium is probably similar to silicon and aluminum; removing the oxygen and oxides, thus leaving the steel in a purified condition. A small amount of vanadium will be found in the steel, and it is very likely has an influence upon the carbon present, which in turn imparts its properties.

Dr. Richard Moldenke lately made an important investigation upon the effect of vanadium on cast iron. The result of the experiments have been published in the Transactions of the American Foundrymen's Association, and showed an increase in transverse strength on test bars of gray iron from 2,000 to 2,500 pounds, and white iron from 1,500 to 3,900 pounds. These results were obtained by adding a few tenths percent. of vanadium in the form of ferro-vanadium, and also indicated that beneficial action could be obtained by so treating molten iron used to make chilled rolls and car-wheels.

NICKEL. The introduction of three to three and one-half percent. nickel in steel causes an increase of about 30 percent. in tensile strength, and fully 75 percent. in the elastic limit, without apparently changing the elongation. Further addition effects the hardness until with 16 to 18 percent. nickel the steel becomes exceedingly hard and difficult to machine. Upon increasing the nickel contents above this point the material becomes soft. The hardening action of nickel upon steel is probably due to its effect upon the carbon.

The action of nickel upon cast iron has been investigated by Mr. J. F. Webb, and reported in the Transactions of the American Foundrymen's Association for 1907. It was found the addition of between one-half and seven percent. nickel "showed no marked improvement in the physical strength of the casting."

Cast iron with 30 percent. nickel is not easily corroded by water or exposure to the usual atmospheric conditions.

CHROMIUM, TUNGSTEN and MOLYBDENUM. These metals alone or in form of ferro-alloys, have but little influence upon cast iron. In steel however they have an important place to fill. Chromium is used in projectiles and tool steel for its hardening properties. Tungsten and molybdenum are employed chiefly in the manufacture of tool or self-hardening steel.

CONCLUSION. It is hoped what has been stated in favor of certain alloys will not cause them to be taken as a panacea for all foundry troubles. When employed in an intelligent manner, that is, with a knowledge of the chemical composition of iron and alloy used, there is no doubt that ferro-alloys will greatly assist the foundryman in the many and not too easy metallurgical problems with which he has to deal.

AMERICAN FOUNDRYMEN'S ASSOCIATION

UNIFORM FOUNDRY COSTS

A memorandum prepared in connection with the chart submitted by the Cost Committee of the American Foundrymen's Association.

By ELLSWORTH M. TAYLOR

The Chart submitted by the Committe has been made as simple as possible, and is designed to illustrate merely the elementary principles of the Burden or Sur-charge distributions agreed upon as the Standard Units to be used by all foundrymen.

It is not intended to be a complete Cost System in itself, nor should the arrangement of the items in the different sections necessarily be maintained, so long as the various kinds of labor and material are distributed to individual costs in accordance with the formula shown.

Briefly stated it has been determined that, in order to correctly obtain the cost per pound of good castings, according to classes or individual patterns, after the cost of the metal and direct or applied labor has been ascertained, certain kinds of Burden or Sur-charge labor and materials must be distributed to each class into which the product may be divided in two general ways:

(1). According to weight of good castings.

(2). According to a percentage of the direct or applied labor used in producing each class.

And in order to get a clearer insight into the subject let us discuss the various sections of the chart in the order in which they occur. We will then take up in a general way the application of the principles to different kinds of foundaries.

METAL

This section of the chart requires little explanation. It is simply necessary for the foundryman to make up his report

(NOTE.—The numbers and letters used in this paper do not refer to the numbers against the items on the chart except where specifically stated. They are used here to permit of a logical arrangement and for the purpose of cross reference within the paper itself.)

showing the cost of the metal *actually consumed* in the making of *the good castings produced.*

This means a fairly close check on what goes into the cupola, and what we ultimately get out of it.

BURDEN OR SUR-CHARGES ON METAL DISTRIBUTED TO CLASSES ON BASIS OF WEIGHT

This section of the chart shows in a general way the kinds of labor and materials which will be distributed to classes or individual patterns in accordance with the *weight of good castings* into which the product may be divided.

In studying the items named in this section of the chart it should be remembered that the arrangement is perfectly elastic, and may be modified and enlarged upon according to the individual requirements and desires of each foundryman. The examples given are merely to illustrate the kinds of labor and materials which are to be included in this section.

It is suggested, however, that in arranging the items in this section the foundrymen group together those expenditures which relate to the successive steps through which the metal passes from the pig up to the finished castings.

For example:

1. Cost of metals delivered at yard.
2. Cost of materials and all expenditures to cupola.
3. Cost of materials and labor to cover molten iron in ladle.
4. Cost of moulding supplies and all items incidental to the same.
5. Cost of all general and miscellaneous items which must be distributed into the costs on a basis of weight of good castings.

The total cost of these items when divided by the weight of the good castings gives the number of cents per pound of Burden or Sur-charge cost to be apportioned to each class of castings or individual patterns into which the production may be divided.

The grouping of the items in this way is to enable the foundryman to analyze his costs logically and make comparisons for the purpose of detecting excessive expenditures.

It is sometimes the wish of the foundryman to group these and other items so as to put the responsibility for the economical

handling of the iron in the various stages up to certain foremen or individuals.

All of these matters, however, must be decided according to individual desires and conditions.

DIRECT OR APPLIED LABOR

The subdivisions in this section are merely suggestive. The list must be added to or decreased to meet conditions. As stated in the note, it is not always possible to class all of the labor of these employees as direct or applied labor, and likewise it is sometimes possible to class all or part of the labor of pattern makers, carpenters and blacksmiths as applied or direct labor.

The rule is that all labor is direct or applied when capable of direct distribution to any class of castings or individual patterns, and when it would be included as a direct labor charge in making up the cost of an individual job. Otherwise the labor items must be classed as Burden or Sur-charge Cost.

The foundryman should be careful to observe this rule when figuring detail costs, as the percentage of Burden or Sur-charge apportioned to individual costs on a basis of direct or applied labor is obtained by dividing the total cost of the Section—"SUR-CHARGE ON APPLIED LABOR DISTRIBUTED ON PER-CENT BASIS" by the total of the "APPLIED LABOR" section.

Therefore, if we include in the applied labor section any considerable amount of labor which does not come within the above named definition of direct labor, we are apt to develop a percentage rate which will not cover our real Burden or Sur-charge.

COMMERCIAL COSTS

This section is intended to cover all costs beyond the shipping office door which have to do with the selling of the product.

Consequently item 80 of the Chart—"Administration"—should be understood to mean only that portion of the executive cost which is used for the benefit of the Selling Department. The balance of the Administrative Cost should be included in item 66—"Proportion of General Office Expense"—or may be made a separate subdivision thereof.

Item 81 of the Chart—"Sales Costs"—may be sub-divided as

each foundryman desires; for example, salesmen's salaries, salesmen's commissions, travelling expense, etc.

In apportioning the Commercial Cost to, the classes into which the product may be divided the unit of distribution should be made up on a basis of equity, taking into consideration the real conditions governing the sale of each class, such as the amount of sales, the costs up to the "COMMERCIAL COSTS SECTION", the difficulty in making sales, the volume of advertising, etc.

Individual conditions must be carefully studied before the unit of distribution for this class of costs is adopted.

SUMMARY OF COSTS

After completing the arrangement of the sections described above we are in a position to secure a summary of costs which may be drawn up as submitted below, changing the arrangement to meet individual conditions.

The grand summary will be based on the following data:

(1) Total good castings produced.

(2) Cost of metals used.

(3) Cost of applied labor.

(4) Cost of total Sur-charge divided into:

  (a) Cost of items to be distributed as "Sur-charges or Burden on metal distributed on Basis of weight of good castings."

  (b) Cost of items to be distributed as "Sur-charges or Burden on basis of % of applied or direct labor."

(5) Total cost of output.

(6) Commercial Costs.

(7) Gross cost of output.

(8) Net cost of metals used per pound of good castings (obtained by dividing item (2) by item (1).

(9) Burden or Sur-charge to be distributed to individual costs on a basis of per pound of good castings (obtained by dividing item (4a) by item (1).

(10) Burden or Sur-charge to be distributed to individual costs on a basis of percent of direct or applied labor (obtained by dividing item (4b) by item (3).

The examples given in this schedule illustrate the classification

of costs necessary for all kinds of foundries, and must be used to meet the conditions in the five general classes of foundries described below, and all others.

THE SMALL JOBBING FOUNDRY SELLING ITS ENTIRE PRODUCT TO THE TRADE

This foundry wants to know:

(a) What is the gross cost of production? See items 5 and 7.

(b) How should we figure the cost of an individual casting? Multiply the weight of casting by item (8). Get the cost of the direct or applied labor used to produce the casting. Multiply the weight of casting by item (9). Multiply the direct labor by the percentage rate obtained by item (10). The total of these amounts is the cost of the casting up to the shipping office door. Add the proper proportion of item (6). The total is the gross cost of the casting.

(c) Suppose it is desired to divide the production into two or more classes, say for example "heavy work" and "light work" so that we may obtain the average cost of these classes without getting the detail cost of each casting? Separate item (1) into "heavy work" and "light work". Keep a record of amount of item (3) used for each class: Then proceed exactly as outlined for (b).

(d) Suppose it is desired to secure the cost of Smith's work, Jones' work, and Brown's work to find out which is the most profitable, and without getting the detail cost of each casting? Separate item (1) according to *customers.* Keep a record of amount of item (3) used for each customer. Then proceed exactly as outlined for (b).

THE JOBBING FOUNDRY LARGE ENOUGH TO BE DIVIDED INTO TWO OR MORE DISTINCTIVE DEPARTMENTS

(e) Suppose one section of a plant is continually producing large loam castings, and another section produces machine made castings? Treat each department as a separate business proposition. This means:

Separate item (1) according to departments. Separate item (3) according to departments. Separate item (4a) according to departments. Sub-divide 4a. First, according to those expendi-

tures capable of direct charge to each department. Second, according to those expenditures incapable of direct charge to each department.

Examine carefully all of the items in the second sub-division of 4a, take into consideration all of the conditions prevailing in each department and apportion the amounts in accordance with the units of equity which the examination develops.

Separate item (4b) according to departments. First, according to those expenditures capable of direct charge to each department. Second, according to those expenditures incapable of direct charge to each department.

Examine carefully all of the items in the second subdivision of 4b, take into consideration all of the conditions prevailing in each department and apportion the amounts in accordance with the units of equity which the examination develops.

Separate item (6) according to departments. First, according to those expenditures capable of direct charge to the sale of castings from each department. Second, according to those expenditures incapable of direct charge to each department.

Examine carefully the items in the second subdivision of (6) and distribute the amounts in accordance with the general instructions given under the heading "Commercial Costs".

When the above distributions have been made we will find ourselves in possession of two sets of reports. Then proceed exactly as outlined for (b) in order to obtain any detail information.

THE FOUNDRY SELLING ITS ENTIRE PRODUCT TO ITS OWN MACHINE SHOP.

With this class of foundry the first step is to treat the two properties as separate institutions. Draw the line sharply between expenditures made for each property, and consider the foundry as an outside concern.

Fix the Selling Prices of the castings to the machine shop taking into consideration general market conditions, and the fact that the foundry will be relieved of the usual Commercial or Selling expense. The foundry must then operate within these theoretical selling prices in order to be profitable.

The next thing to consider is whether the foundry is large enough to warrant sub-dividing it into departments.

If it is not necessary to make these departmental subdivisions we will obtain our costs and detail in the same general manner as outlined for (a) and (b).

If a departmental subdivision into departments is advisable for any reason proceed in the manner outlined for (e).

THE SMALL FOUNDRY SELLING PART OF ITS PRODUCTS TO THE TRADE FOR CASH AND THE BALANCE TO ITS OWN MACHINE SHOP

This class of foundry may be handled in several ways, the suggested division of the production being:

1st. Cost and profits on castings sold to outside customers.

2nd. Cost and profits on castings sold to machine shop.

To get this information proceed as outlined for (d), being careful to apportion the Commercial or Selling Costs as between the two divisions of the product.

If we wish to obtain detail costs proceed as outlined for (b) and by posting these costs against sales we may get profits on individual jobs or by any class desired.

If we desire to divide our product first into perhaps "heavy work" and "light work" without going into the detail cost of each job, proceed as outlined for (c). And if it is still our wish to secure figures in the broad divisions of:

1st. Costs and Profits on castings to "Outside Customers".

2nd. Costs and Profits on castings to machine shop.

we must divide (1) and (2) into the pounds of "heavy work" and "light work" in each class, and multiply the amounts by cost as developed by (c).

If we further wish to sub-divide costs of "work for outside customers", by customers, such as Brown's work, Jones' work, etc., we must know the pounds of "heavy work" and "light work" produced for each. Then multiply the amounts by the cost developed by (c).

THE LARGE FOUNDRY CAPABLE OF SUB-DIVISION INTO DEPARTMENTS AND SELLING PART OF ITS PRODUCT TO THE TRADE FOR CASH AND PART TO ITS OWN MACHINE SHOP

This class of foundry has the greatest complications and likewise the greatest possibilities for the application of the principles enumerated, and as its costs will be determined primarily by a combination of the illustrations given it does not seem necessary to go into much description.

A careful reading of the outline for (e) and for "THE SMALL FOUNDRY SELLING PART OF ITS PRODUCTS TO THE TRADE FOR CASH AND THE BALANCE TO ITS OWN MACHINE SHOP" should give a clear idea of points to be covered.

GENERAL REMARKS

In reading this paper it should be borne in mind that the intention is to illustrate correct principles of distribution and not to outline a complete cost system.

No attempt is being made to deal with the subject of handling of patterns, the handling of orders, the handling of metals, the record of stock, the books of account, statistics, etc.

All of these matters come under the heading of a cost system, and they were treated of in a general way by the writer in the paper prepared for the convention of the American Foundrymen's Association held in New York City in June 1905.

BY-PRODUCT COKE FOR THE FOUNDRY

By GEO. A. T. LONG, Chicago, Ill.

A few words on foundry coke made from by-product ovens, may be of interest to the members of the Association who have not had opportunity of trying this coke in their plant, or who have not had satisfactory results with it in trials which they have already made.

The requisites for a good foundry coke are—first, high carbon; second, low sulphur; third, good cellular structure, and fourth, that the product shall be uniform. The carbon and sulphur are primarily the result of the quality of coal which is used in the ovens for coking purposes. The structure, however, depends upon the proper preparation of the coal before coking and also upon the arrangement of the oven in which the coal is coked and upon the temperature of the coking chamber. It does not, therefore, follow that all by-product cokes are necessarily good foundry cokes, any more than that all bee-hive cokes should be equal to Connellsville. There are, however, certain plants of by-product coke ovens which have made a specialty of manufacturing coke for foundry purposes and have given special attention to the selection of their coals, and they are producing a coke which contains all of the qualities which go to make up a desirable coke for foundry purposes.

These plants are located at Syracuse, New York; Detroit, Michigan; Chicago, Illinois; and Milwaukee, Wisconsin. The

Solvay Process Company, of Syracuse, New York, are the selling agents for the Syracuse Plant; Baird & West, of Detroit, Michigan, are selling agents for the Detroit plant, and Pickands, Brown & Company, with offices at Chicago and Milwaukee, are agents for by-product coke from the Chicago and Milwaukee plants.

These are the only Companies, so far as we are informed, that are making and selling a by-product coke that is especially manufactured for foundry purposes. There are a number of other plants of by-product coke ovens at other points in the country which are manufacturing coke for blast furnace or domestic use. Coke from these plants, where the coals have not been carefully selected has sometimes been bought by foundries with very unsatisfactory results. You would not buy any bee-hive coke which was offered you, without ascertaining whether it was especially adapted for foundry purposes, and you should not, therefore, buy retort coke simply because it is retort coke, but should know before taking it into your plant that it has been produced by a by-product plant who understand the requirements of the foundry trade and are known to be producing a standard foundry article.

From my experience in conducting tests with by-product coke made especially for foundry purposes since its introduction in America, will say to-day that it will carry more iron than any other coke in the market. Why? Because it has the structure, is high in carbon and low in sulphur. We all know what an enemy sulphur is to iron. How often have we had to change our mixture or add an alloy to produce castings when we got a car of high sulphur coke, so that we could machine them, and it cost us more for our loss on one car of this kind of coke than our fuel would for ten cars standard foundry coke.

I claim to-day that by-product foundry coke, such as is produced at the plants above named, will give better results with all kinds of iron melted in a cupola, let it be for stove plate, machinery or car wheels, high or low carbon irons. Car wheels require more coke to melt than stove plate or machinery, owing to the use of low carbon irons, and more carbon has to be supplied to metal, as a mixture going into the cupola is 3.20 in total carbon, and a wheel should contain 3.50 to 3.55 total carbon,

and the difference must be supplied from the carbon in the coke. Therefore the higher carbon in the coke the less fuel it takes to melt the metal and the better the casting. For instance, I was called a short time ago to investigate a little trouble they were having at a certain plant in the West. On reaching the plant I found that they were using the same iron right along, had not got any new iron in five months, and knew the analysis of every car on the ground. They were using 6,000 pounds of iron to each charge and 720 pounds of coke, before their iron would be fluid enough to run their castings, but their trouble was in their machine shop. They were using a Connellsville coke which stood .98 sulphur, 83.00 fixed carbon, 13.00 ash. While I was there they received a car of by-product foundry coke, which ran .54 sulphur, 91.00 fixed carbon, 7.23 ash. After starting this coke going I had to cut down after the bed charge to 600 pounds to each charge of 6,000 pounds of iron. Also increased the scrap 15%, which made stronger castings and remedied all the trouble in the machine shop. In this case, the charge of 720 pounds of Connellsville coke contained 7.05 pounds of sulphur and 597 pounds of carbon, while the charge of 600 pounds of by-product coke contained 3.84 pounds of sulphur and 546 pounds of carbon, approximately half the sulphur and only 50 pounds less of fixed carbon, although using 120 pounds of coke less per charge. This is a fair comparison of foundry cokes. No doubt you have all been against this same thing.

THE PRODUCTION OF AUTOMOBILE CYLINDERS

By L. N. PERRAULT, Waterbury, Conn.

The automobile has undoubtedly done more than anything else to develop the highest degree of skill and accuracy in the foundry. The successful making of the various types of cylinders demands the utmost painstaking, intelligent forethought and supervision. To such an extent is this feature carried out, that some foundries which make a specialty of this class of work, find it profitable and even necessary to employ a skilled man, whose sole duty consists of a constant oversight of each new job, from the arrival of the drawings or patterns; noting the efficiency (or lack of same) with which each operation is conducted and conferring with the Supt. and foremen on points noted, until all are satisfied that no further improvement can be made to hasten production or better the product.

A thorough knowledge of the subject (which can be acquired only by long experience) is indispensable to the foundryman, who hopes to make a success of casting water cooled cylinders with the jackets integral. His judgment is also indispensable to the designer, who many times sees only the virtues of his design as compared with others, and either doesn't recognize or ignores the dangers of same from the foundry point of view. Again, unless the man who makes the pattern has a liberal foundry experience and knowledge, his ideas of making the pattern and core boxes so that the molds and cores can be readily assembled would be laughable, if the foundryman could be in-

duced to laugh after spending several hours filing, scraping and fitting the cores, and trying them into the mold again and again in an endeavor to get an even thickness around ports, valve chambers and jacket walls, so that he may get a sample casting to cut open for inspection, which is a wise move if the order is large, for a casting sawed into a number of sections and along the right lines, exposes every imperfection. With the most skillfully made patterns and core boxes it is often necessary to make some slight alterations after the cylinder is cast, and it seems almost wonderful that the pattern maker can work so closely to the many curves and odd shapes as he does and not vary more in the thickness of the metal walls.

Take for illustration, the twin cylinder unit in common use in the two, four and six cylinder cars both here and abroad. In some patterns, the entire core with the exception of the barrel cores and consisting of the top and bottom jacket, two ports, one inlet and one exhaust core are assembled and pasted in a form (which may be made of iron, plaster of paris or oil sand, and which is an exact replica of the bottom of the mold) then dried in the oven and when ready, set into the mold as one core. In this case one can readily see the necessity of each core having suitable provision made for locating and locking into exact place, for the variation of even 1-64 of an inch in one core only would cause the casting to be scrapped. In other patterns of the same outward design, the bottom jacket core is first located in the mold, next the barrel cores, which in this case have port and valve seat cores made integral with them, are set; then the second section of jacket core is pasted in place, and first cheek closed; next the inlet and exhaust cores are set in place and the top jacket pasted on, and then dried in the mold with a gasoline torch and the second cheek and cope closed and clamped ready to cast. Either method is reasonably safe, but of the two, the writer prefers the second, as one has the opportunity to see that the cores are properly located after each operation. On this work, it is very necessary to have just the right materials for making both the mold and cores.

Consider for a moment the skill and accuracy called for on the part of the core maker, which enables him to make a jacket core as large as a water bucket, varying in thickness from 3/8 of an inch in some parts to 2½ inches in others, and which must

successfully withstand a pressure of 1/8 of an inch of metal outside against 1/2 inch pressure from the inside. How nicely must the interlacing of wires and wax vents be carried out, first, to support the core against this pressure and in the right location, and second, to furnish a free and quick egress for the rapidly generated gases.

THE ENORMOUS INCREASE IN DEMAND.

Only a few years ago the American foundryman who could successfully make automobile cylinders was looked upon as a wonder and was a much talked of man among the fraternity. Even then his best efforts only produced a good one now and then, and his daily production per man is exceeded hourly today, owing to the experience that time has brought about simplifying the design and construction of both patterns and core boxes, as well as educating some of our brightest molders, who have been quick to appreciate the advantages of being specialists in this very interesting line of work. The writer has seen some of the prominent automobile builders increase their output several hundred per cent. in the past few years, starting with only one model, and that largely an experiment until now their line includes several types, all of which are standard and wholly successful, and today there are several foundries in America, which devote the greater part of their time to supply this great and growing demand for automobile cylinders.

The great stress laid upon the necessity of saving in weight by the automobile engineer has made thin castings a necessity in cylinders with the water jackets cast integral. Little by little the thickness has been reduced until the danger line was reached, when strengthening ribs were added, these coming as they do in the jacket core boxes, make the problem all the more difficult for the foundryman. Again the presence of bosses for the various studs, etc., often necessitate the use of internal chills to hasten cooling and prevent shrinkage. The enormous strains put upon the cylinders in actual service by reason of vibration, and the unequal heating of different parts by the exploded gases, makes the question of strength an important one. Strong irons are by reason of their chemical composition inclined to be rather hard when cast into such thin sections, yet the engineer demands a strong casting, which must machine uniformly, and be

absolutely free from either hard or spongy spots and sound in bosses and jackets.

As the result of careful study and patient experiment, the writer has settled on a mixture, which has stood the test of time and has been uniformly satisfactory giving a tensile strength of about 36000 lbs. per square inch. Strange and complex are the opinions of some of the designers with whom we come in contact in the course of our investigations. An illustration, A says "I wouldn't use any but 'French' castings, they are the only good ones made." He kindly allowed me to take borings for analysis. B says "I have had them from France, Germany and Italy, but the only man I ever knew who could turn out a decent cylinder, was in a little shop in England and he makes all of mine." I append the analysis of both, selecting these as the two extremes for your consideration.

France.		England.	
Sil.	1.72	Sil.	2.73
Sul.	.110	Sul.	.083
Phos.	1.100	Phos.	1.141
Man.	.590	Man.	.41

MOULDING

When the size of the order will permit interchangeable iron flasks should be used, these should be as light as is consistent with safety, for in three or four parted work, the handling of flasks is quite an item in the molders labor.

The patterns and core boxes should be of metal, or if wood, the parts most exposed to wear should be protected by metal facing, all loose bosses, etc., so fitted that even the slightest displacement can not occur and such bosses as will permit of it should be cored to avoid shrinkage, for every part of the cylinder must be tight to stand the strains of service. The sand should be of fine texture and open grained, very carefully mixed or ground and worked rather dry, and well blackened with a good grade of plumbago. These points, if carefully observed, should produce smooth sound castings in green sand.

The following methods of molding are used in our foundry, each of which is goverened by the type of pattern, size of order etc. First; In this case one molder makes and casts his work. Second; The different parts of the pattern are fastened

to moldboards and skilled molders used on the difficult parts, and cheaper men on the simpler parts while the coreing, closing etc. are done by another gang and the molds cast by laborers. Third; The patterns mounted on molding machines operated all day by one gang while the coresetting, casting, etc., are done by others. The writer has in mind a certain cylinder, for several years molded by the first method at a cost per cylinder of 66⅔ cents each, which was later made on a three parted molding machine at a cost of 16 cents each, and on which there was a saving in cost in machine shop of 25% over the old method of hand molding.

CORE MAKING

Iron forms should be made for such cores as need support while drying, others also for shaping the core wires. This can be done by a boy or laborer and stored till wanted. The sand should be strong, sharp and sufficiently fine to give a smooth surface. We prefer an oil binder for obvious reasons. The wax vents must be of a composition which will neither flatten out nor break under the rammer, and which will melt readily in the oven, and be absorbed by the sand with no detriment to the core (some wax leaves the core rotten about the vents and is liable to give way to the pressure of the iron while being cast, causing the loss of the cylinder).

The wires should be pliable, yet strong enough to hold their shape when set, and are led to all parts of core in a manner which will permit their ready removal when cast. This is necessary not only for support, but they assist greatly in the removal of the core, which becomes somewhat loosened by their withdrawal and flows through in their wake. After drawing off the box all jacket cores should be carefully examined for exposed wires or vents, and same remedied before being placed in the oven. After being dried, cores should be well blackened and again dried, and if to be assembled and pasted by the coremaker, should be accurately measured by the proper forms and guages and set aside ready for the mold. Our practice is to have the sand and oil carefully measured, mixed and stored in bins and delivered to the benches, the cores placed in the ovens and again delivered to their makers by a gang of laborers, this confining the whole of the coremakers time to the skilled

part of the production. The ovens are fired at night only, and the heat regulated by pyrometers which insures a perfect bake.

Each foundry should have their own wax vent machine (the writer will gladly recommend a good one, on inquiry) with dies for the various sizes needed. One man by two hours work with same, can turn out vents enough to supply a hundred coremakers.

There are various compounds in the market, which are of good quality but more expensive than that made on the premises need be.

CASTING THE CYLINDERS

The iron should be melted "hot" and handled as quickly as possible to avoid cold shuts in the jackets, also because a casting poured hot is more likely to finish sound than one poured dull. With good sized pouring basins and risers where needed, hot iron of the right mixture, sound cores and a well made mold, the losses on this class of work will be about the usual foundry average.

CLEANING

We prefer to pickle our castings, first, because there is less risk of breakage than in tumbling, and second, because pickling softens the skin or scale which otherwise is hard on the cutting tools, and lastly because dirty spots or other blemishes are more apt to be readily found than in a black polished surface.

Our method is as follows:—The gates, risers and fins are first removed, next the wires drawn out and the casting lightly tapped with a hammer and rolled from side to side on a plank, bringing each cored hole in turn to the bottom so that the core sand may flow freely out, then at last running a wire from the cored hole to all the remote places and making sure that all the sand is out. The casting then goes to the pickling bench, is well drenched and left till the following morning, when it is washed and goes to the inspector, who carefully looks it over for outward defects and if none are apparent, measures it with the proper guages and sets it aside to be chipped and filed. The castings are next subjected to a hydrostatic pressure of 100 lbs. to ascertain if there are any leaks from the water jacket both

externally and internally. This done if good they are ready for shipment.

In closing the writer feels that he has left unsaid much that would be of interest and trusts that a liberal discussion on this very interesting subject by the many able foundrymen assembled at your convention will follow.

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TITANIUM IN CAST IRON

BY DR. RICHARD MOLDENKE, WATCHUNG, N. J.

Among the numerous applications of electrical energy, none stands higher in the eyes of the iron and steel metallurgists than the electric furnace. Ferro-alloys in which metals formerly regarded as practically infusible can now be obtained for simple addition to the ladle and their effect studied, and the reduction of the cost to a commercial point has brought us nearer to the much sought goal of physical perfection in our iron products.

Probably no one man has done more to study the scientific and commercial side of titanium as applied to iron and steel than Mr. Auguste J. Rossi. From having the blackest kind of a reputation in the blast furnace, Mr. Rossi has given titanium a place in the metallurgy of iron which is beginning to grow in importance. The benefit to be derived from a formerly despised material and the eventual opening up of immense resources of ore heretofore considered valueless, will remain the best monument of a career of unselfish labor and sacrifice.

Of the two methods of preparing titanium for use in iron, the Alumino-thermic and the electric furnace, the latter seems destined to make the cheaper product, and as the selling price of a 10% titanium-iron alloy is now within commercial limits, its use for the foundry is worth considering closely. For this purpose a series of tests was instituted on behalf of the American Foundrymen's Association, the results of which are given herewith.

In the preliminary tests two classes of alloys were tried, one in which the material was free from carbon, and the other having some 5% of this element present. The tests showed that while both alloys could be used for the rather small quantities

of iron treated, the carbon-titanium alloy was better adapted for foundry work, as the melting point is lower. None the less, however, the alloy free from carbon can be used in the foundry where large bodies of metal are to be treated, and time can be given for a thorough incorporation of the material.

The apparent infusibility of the titanium-iron alloys has heretofore militated heavily against their use, and hence a word about the matter. When the lumps of alloy are thrown into the ladle, they must be given time enough to heat up and alloy with the bath by thorough stirring. This takes some time, and usually, especially with steel, fear that the metal may cool too much results in pouring before the titanium has gotten in its work. Hence the writer suggests that where large lumps of either alloy are used that these be heated up to redness in any convenient way before use.

In making the tests in question, the standard 1¼ D. test bar cast on end in a dry sand mold was used. The bars were brushed clean and then tested transversely on supports 12″ apart. Two classes of metal were used. Broken car wheels and machinery pig iron. This gave gray iron and white iron castings. The alloy contained 10% titanium, so that one lb. alloy to 100 lbs. iron would mean the addition of 0.1% titanium.

TABLE I.

MACHINERY PIG (gray iron). No titanium alloy added.

No. 1	broke at 2,240 lbs.	with .10″ deflection.
2	2,260	.10
3	2,010	.09
4	1,840	.08
5	1,970	.08
6	2,150	.10
7	2,100	.10
8	1,770	.09
9	1,890	.10
Average	2,020 lbs.	.09″

Analysis of Pig Iron—Silicon 2.58, Sulphur 0.042, Phosphorus 0.540, and Manganese 0.74.

TABLE II.

MACHINERY PIG (gray iron). 0.05 titanium (no carbon) added.

No. 10	broke at 3,140 lbs.	with .09″ deflection.
11	2,750	.09
12	2,880	.09
13	3,070	.09
Average	3,100 lbs.	.09″

TABLE III.

Machinery Pig (gray iron). 0.05 titanium (carbon) added.

No. 14 broke at	3,050 lbs. with	.09″ deflection.
15	3,140	.10
16	3,150	.10
17	3,230	.10
18	2,850	.10
19	2,990	.09
Average	3,070 lbs.	.10″

TABLE IV.

Machinery Pig (gray iron). 0.10 titanium (no carbon) added.

No. 20 broke at	2,880 lbs. with	.09″ deflection.
21	3,070	.09
22	3,150	.09
Average	3,030 lbs.	.09″

TABLE VI.

Machinery Pig (gray iron). 0.10 titanium (carbon) added.

No. 23 broke at	3,080 lbs. with	.09″ deflection.
24	2,850	.09
25	2,850	.09
26	3,150	.10
27	3,050	.10
28	2,880	.10
Average	2,990 lbs.	.095″

TABLE VII.

Machinery Pig (gray iron). 0.15 titanium (carbon) added.

No. 29 broke at	3,270 lbs. with	.11″ deflection.
30	3,030	.10
31	3,270	.10
32	3,180	.10
Average	3,190 lbs.	.10″

A test with 0.15 titanium in the alloy free from carbon failed as the metal had to be poured before the alloy was completely dissolved.

TABLE VIII.

Machinery Pig (gray iron). Titanium alloy free from carbon placed on the coke bed of the cupola, and metal charged above making the titanium addition 0.10%.

No. 33	broke at 2,540 lbs.	with .09″	deflection.
34	3,020	.10	
35	3,000	.10	
36	2,740	.11	
37	3,260	.10	
38	3,300	.10	
39	2,420	.10	
40	2,300	.09	
41	2,880	.09	
42	2,810	.09	
43	3,250	.10	
44	2,570	.09	
45	2,980	.10	

Average not taken as the results show irregularity due to portions of the metal being treated and other portions not.

It will be noticed that the variation in strength is from 2,300 up to 3,300, or practically the range of results obtained by adding the alloy to the ladle, but the results are not uniform.

TABLE IX.

SCRAP CAR WHEELS (white iron). No titanium added.

No. 46	broke at 2,110 lbs.	with .05″	deflection.
47	2,100	.05	
48	2,110	.05	
49	2,000	.05	
50	1,920	.04	
51	2,060	.04	
52	2,070	.05	
53	2,010	.04.	
Average	2,050 lbs.	.05″	

Analysis of Car Wheels:—Silicon 0.85, Sulphur .07, Phosphorus .420, and Manganese 0.60.

TABLE X.

SCRAP CAR WHEELS (white iron). 0.05 titanium (no carbon) added.

No. 54	broke at 2,310 lbs.	with .06″	deflection.
55	2,660	.06	
56	2,260	.05	
57	2,210	.05	
58	2,440	.05	
59	2,420	.05	
60	2,400	.05	
61	2,440	.05	
62	2,480	.05	
63	2,440	.05	
64	2,310	.06	
Average	2,400 lbs.	.05″	

TABLE XI.

SCRAP CAR WHEELS (white iron). 0.05 titanium (carbon) added.

No. 65 broke at	2,420 lbs. with	.05″ deflection.
66	2,610	.05
67	2,340	.05
68	2,720	.06
69	2,230	.06
70	2,430	.05
71	2,440	.05
72	2,320	.05
73	2,300	.06
Average	2,420 lbs.	.05″

It was not possible to get good results with larger quantities of the alloy free from carbon, as the white iron chilled too quickly.

TABLE XII.

SCRAP CAR WHEELS (white iron). 0.10 titanium (carbon) added.

No. 74 broke at	2,380 lbs. with	.05″ deflection.
75	2,460	.05
76	2,440	.05
77	2,340	.05
78	2,420	.05
79	2,320	.05
80	2,360	.05
81	2,440	.05
82	2,400	.05
83	2,400	.05
Average	2,400 lbs.	.05″

TABLE XIII.

SCRAP CAR WHEELS (white iron). 0.15 titanium (carbon) added.

No. 84 broke at	2,600 lbs. with	.06″ deflection.
85	2,590	.06
86	2,500	.06
87	2,620	.06
88	2,300	.05
89	2,580	.06
90	2,280	.06
91	2,590	.07
92	2,430	.06
93	2,600	.07
Average	2,520 lbs.	.06″

SUMMARY OF RESULTS:

	Gray.			White.		
Original Iron	(9 tests)	2,020	Lbs.	(8 tests)	2,050	Lbs.
plus .05 Ti	4 "	3,100	"	11 "	2,400	"
plus .10 "	3 "	3,030	"			
plus .05 " and C	6 "	3,070	"	9 "	2,420	"
plus .10 " " "	6 "	2,990	"	10 "	2,400	"
plus .15 " " "	4 "	3,190	"	10 "	2,520	"
	23			40		
	Average	3,070	Lbs.		2,430	Lbs.
Increase in strength, treated iron over original		52%			18%	

From the above summary it will be seen that the greatest increase in strength was brought about in the gray iron, which is of interest in connection with the recent tests made with Vanadium in Cast Iron where the contrary was observed. The Improvement in gray iron is more marked than was the case in tests made by Mr. Rossi and the writer in 1902. The same peculiarities, however, were observed in the behavior of the metal, as will be described later.

Looking over the averages above presented, it will be noted that the improvement is almost as marked whether 0.05, 0.10, or 0.15 titanium was used, which would seem to indicate that once the deoxidation has been effected, any additional titanium added is partially wasted. Hence for ordinary foundry practice 0.05 titanium added will be practically sufficient, larger amounts only being necessary in exceptionally bad cases or for special work.

A further curious fact in connection with the use of titanium in the foundry is the lessening of the chilling action. And yet whatever chill may remain shows very much harder iron. This is important in car wheel work. Test pieces made in the Keystone Car Wheel Works with iron which chilled 1½" deep, when treated with titanium in the ladle gave but 1" chill. Prisms cut from these chilled portions, the castings having been made from the same metal, when subjected to compressive strain, and also tested for hardness with Brinel's test (use of diamond) gave the following results. (Tests made by Mr. Hokanson at the Carnegie Technical Schools.)

Original iron crushed at 173,000 lbs. per sq. in. and stood 445

in the test for hardness, soft steel running about 105. The treated piece ran 298,000 lbs. per sq. in. and showed a hardness of 557. Testing the soft metal below the chilled portion for hardness gave 332 for the original and 322 for the treated piece, or practically the same material so far as hardness was concerned.

The writer wishes to call attention to another curious phenomenon in connection with these tests. In order to see what effect the remelting of a titanium pig iron would exhibit, a special batch made in the electric furnace, containing 3.14 titanium, and 5.78 graphite, was run through the cupola. The product was cast into test bars the usual way, and part of one ladle into a chill cup. The metal as it came from the electric furnace originally was so tough that it could be broken only with severe exertion. Much of this strength was lost in the cupola remelt, and the composition of the bars was as follows:.

Silicon	0.97
Sulphur	0.067
Phosphors	0.064
Manganese	0.27
Graphite	3.18
Total Carbon	3.94
Titanium	0.72

An average of the eleven bars cast gave 2,290 lbs. though this is of no special value, lacking comparison with anything.

The bars were dark gray, where one would expect a heavily mottled or at least only very light shade of gray to exist, considering the composition and comparatively small diameter. It was noticed, however, that the bars when cast retained their red heat at least three times as long as ordinarily, and this opportunity for graphite to form may account for the dark gray fracture.

Now the further curious fact with this experiment was seen in the chill piece cast from the same ladle as some of the bars. The metal set in such a way that a large excrescence was forced out at the top, as shown in the illustration. Further when the chill piece was broken, the fracture showed distinctly the cross of St. Andrew, in its crystallization, (but faintly reproduced in the illustration). Incidentally the graphite of the chilled piece was 0.05, the other constituents being practically the ones given.

Just what may be the true explanation for this must be left for future investigation, but perhaps some light may be thrown upon the subject by the following. Experiments made by Mr. Fitzgerald at Niagara Falls, in treating molten iron with 1% titanium, the bath of metal being 2,300 degrees F. showed that the addition in question raised the temperature some 25 degrees for a minute, and then slowly dropping to the original again. Evidently there was a reaction involving the giving out of heat.

Possibly this may account for the long continued redness of the test bars cast in dry sand molds.

Further, it is well known that a burnt heat causes badly "skulled" ladles, the slight drop in temperature of what looks like highly overheated metal being sufficient to do this. Here is a case of raising the melting point of the metal through oxidation. Possibly by the addition of titanium, and the consequent removal of this oxidation or even of absorbed nitrogen, more particularly noticeable in steel work, the melting point is dropped

again, and longer continued fluidity gives rise to the phenomenon above described.

While this cleansing action of titanium is exceedingly interesting to the iron founder, the producer of copper is really far more concerned. Titanium copper alloy, when added to molten copper, deoxidizes it so rapidly that it is perfectly possible to make absolutely sound copper castings with a very small addition of titanium. The writer cannot present much along this line at present but hopes to do more later on. In the meantime the experiments with titanium and other alloys will be continued on behalf of the American Foundrymen's Association, and the result duly reported to the membership.

FOUNDRY COSTS*

BY ELLSWORTH M. TAYLOR, BOSTON, MASS.

Costs; the pulse of your business, indicating absolutely the trend of your business vitality.

During the past decade the business methods of manufacturing and producing plants have been entirely revolutionized by the introduction of modern ideas, while the foundry has until recently been practically neglected.

Manufacturers have been brought to realize that they cannot get the full benefit of the introduction of improved mechanical appliances without knowing unmistakably the actual effect these appliances have on the cost of the product.

The old method of estimating selling prices by guessing at the original cost has rapidly been discarded, and facts hitherto allowed to remain in the head or heads of one or two or three employes, as the case may be, have been transferred to positive records, and constitute a tremendously valuable working asset of the business.

A man must die, but the experience of years must live to assist the next generation in bringing the business to the highest state of perfection, without being compelled to travel over the old ground again.

In other words, this is an age of industrial progress and men cannot afford to waste time in solving problems which have once been met and mastered.

The modern business man is practical, if nothing else, and he knows that to conduct his affairs successfully he must have cold hard facts. He measures every step by the dollar rule.

The properly regulated, modern cost system is the relentless eye constantly examining and scrutinizing every nook and corner of your business, calling your attention automatically to leakages and excessive expenditures, substantiating or disproving what-

*Reprinted from Transactions of the New York Convention. This paper to accompany Mr. Taylor's memoir on Uniform Foundry Costs, p. 37.

ever information may have come to you verbally or by observation, enabling you immediately to use all your energy and brains to cure the sore.

"Why is it," asks the manufacturer, "that we only show a profit this year of 12 percent as against 20 percent one year ago? We have been operating under practically the same conditions and have figured our selling prices in the same way."

There is evidently a serious error in your costs. Your direct labor on certain jobs has greatly exceeded your estimate, the amount of your burden or unseen dollars has exceeded your expectations; your orders have actually happened to run to that class of goods which you are regularly selling at a loss because you have no accurate method showing what your actual burden or unseen dollars amount to, and your method of applying an inaccurate burden to your first cost to establish your selling price is radically wrong.

Your crude method of using your pay roll and material expenditures gives you no proper line on your leakages, your personal observation and verbal reports deceive you as to true conditions, and leakages which you should measure in dollars and cents at least once a month, you allow to go undiscovered until the end of a fiscal year, when it is too late.

You are making a gambling proposition out of a legitimate industrial business.

You carry an insurance policy on your life, you protect your property against loss by fire, but you are not carrying a cost policy drawn up on lines which protect the most vital part of your business.

To illustrate how easy it is for the foundry man to fool himself in regard to his costs, one example will suffice.

Some capitalists were considering the advisability of investing one hundred and fifty thousand dollars in cash in an established business including a foundry and machine shop.

The statement had been made that the iron castings were costing at an average not more than one dollar and sixty-seven cents a hundred pounds.

I was delegated to visit the plant and conduct a general investigation. In order to test the accuracy of the foundry costs, I selected a month in which it was claimed the cost was one dollar and seventy-seven cents per hundred pounds.

On examining the cost method I found that several important points had not been taken into consideration. I drew up the data in the proper manner, supplied the missing links, and the actual cost of the castings was found to be two dollars and thirteen cents per one hundred pounds, and not one dollar and seventy-seven cents.

Part of the product of this foundry was sold to the machine

shop and figured in the machine shop costs at two dollars per one hundred pounds, and the balance was sold to the trade at an average of about the same amount.

Thus this foundry was actually losing money at the rate of thirteen cents per hundred pounds instead of gaining twenty-three cents as shown by their cost report.

The existence of this leakage was a great surprise to the officers of the company and they immediately acknowledged the inaccuracy and weakness of their cost method.

Of how much value is this kind of information to the foundry man?

It may mean the very life of his business.

Accurate cost methods are of equal value to the small and large foundry and the general scheme of foundry costs is the same whether you are operating a jobbing foundry or a foundry in connection with a machine shop.

As a matter of fact, the machine shop foundry must be considered in the light of a jobbing foundry. That is, the treasurer of the company agrees to buy the entire output of the foundry for a certain period at certain fixed prices, and the foundry must produce good castings at a cost sufficiently less than the market offers to warrant the treasurer in setting the foundry up in business.

If the foundry cannot do this, it would be to the advantage of the business to close the foundry and buy the castings outside.

And the treasurer cannot afford to fool himself as to the actual conditions.

He will have installed a monthly cost report, divided into three general sections: Metals melted, producing labor, expense.

The monthly postings to these sections will be made up as follows:

MATERIALS.

In every foundry there are certain materials which are purchased from hand to mouth; that is, in quantities which are practically used up from month to month. Materials of this kind are usually miscellaneous supplies, such as molasses, facing, flour, small hardware, etc.

From the cost and accounting standpoint it is best for every foundry to draw up a list of all materials of this nature and as soon as the invoices covering these materials are received and O. K'd, the face value of the invoices should be immediately charged off into the proper subdivision of the expense section of the foundry cost operations for that period.

At the end of each month the accumulated totals of these items will be posted to the monthly cost sheet.

Invoices covering heavy materials, such as the different kinds

of metals, coal, coke, sand, lumber, etc., should be charged into a general foundry stores account, and a stock ledger account in card form should be kept of each different kind.

These ledger cards will be debited in the first place with an inventory of the quantity on hand, and thereafter with the quantities as they are received.

A daily melt record must be kept showing in detail and by actual weight the quantities of the different kinds of materials which have passed over the cupola floor.

This daily record must pass promptly to the cost department and the quantities shown must be posted to the credit side of the ledger card covering that particular material.

In the case of all heavy materials which do not pass over the cupola floor, methods must be provided for daily records of quantities used. Take sand, for example. Pads should be nailed up in a convenient place in the path of the employe whose business it is to transport the sand from the sand bins into the foundry proper. Each time a load of sand is carried in a mark must be made on the pad. The capacity of the wheel-barrow or other conveyance is known and the quantities used may thus be easily obtained.

These records must also be transmitted to the cost department and corresponding entries made on the ledger cards.

The ledger accounts must be closed each month, and the quantities of *metals* used will constitute the gross melt for the month under the "Metals Melted" section of the cost sheet.

The quantities used of all other heavy materials will be carried into the proper sub-division of the "*Expense*" section of the cost sheet.

These card ledger accounts must be periodically checked up with the actual quantities on hand, and thus constitute a check on the accuracy of the daily reports.

In brass foundries particularly the importance of this close check on materials cannot be over-estimated.

LABOR.

The pay roll must be divided into two general classes, productive and non-productive.

From a cost keeping standpoint, productive labor includes only such labor as is capable of being charged direct to a certain casting or job.

The importance of distinguishing productive labor must be emphasized, because in analyzing your costs the productive hour or the produtive dollar is the acknowledged unit of distribution for all foundry expense or burden dollars.

Labor of this kind will be made up principally from the money

paid to molders, but in some cases will include helpers and core makers.

Non-productive labor is all labor, including clerical work which for any reason whatever is incapable of being charged to a particular casting or job.

There are in every foundry a certain number of general utility men who are really direct producers, but who spent only two or three minutes consecutively on any particular casting or job.

From a clerical and practical standpoint it is not often feasible to attempt to charge two or three minutes to a certain casting, and for this reason all such work must be classed as non-productive and included in the proper sub-division of the expense section of the cost sheet.

EXPENSE.

In addition to the material and labor distribution to the expense section, there must be charged in each month a fixed sum which is one-twelfth of the total amount of private pay roll, insurance, taxes, interest, depreciation, and all other items incapable of direct distribution.

The cost sheet is then ready for certain final postings which must come from the monthly production sheet described below:

PRODUCTION.

A daily record must be kept which will give:

First—The gross quantity of salable castings produced.

Second—The gross quantity of foundry tools and temporary equipment produced.

Third—The gross quantity of bad castings returned from machine shop or customers.

Fourth—The gross quantity of bad castings detected in foundry.

Fifth—The gross quantity of gates, sprues, runners, etc., made. The accumulated totals of these items posted to the proper divisions of the monthly production sheet give the gross pounds which can be accounted for out of the metals melted and the pounds lost in melting.

The totals of items two, three, four and five must then be credited to the cost sheet record of gross melt and in this way an amount is developed showing the net number of pounds actually used to produce the net quantity of salable castings.

Reducing these weights to dollars and cents and combining with labor and expense data on cost sheet gives you the cost of your product, and your loss or gain.

If the production sheet is properly designed, it will establish beyond a doubt the reason for any fluctuation in cost one month as against another.

This method of working the cost down from gross metals

melted to net quantities and values is an absolute check against serious error, whether clerical or physical.

For instance, suppose the figures show a greater quantity of salable castings produced than pounds of net material used. Or suppose a loss in melt is developed of more than 7 percent? In the first case, if the error is merely physical, your costs are seriously affected. Or, if you are operating on a piece-work basis, you may have paid for more castings than have actually been produced.

In the second case the error may be physical, or there may be serious trouble with your cupola. In either case the subject requires careful consideration and investigation.

A close scrutiny of all the facts set forth on these monthly reports will likewise give the foundryman a line on the actual efficiency and condition of the entire foundry.

ANALYZING COSTS.

In the large iron foundry comprising green sand, dry sand, loam and machine departments, it is necessary that the daily reports and records provide for a distribution of labor, castings produced and castings lost by departments.

In the jobbing foundry it is important to know the relative value of each customer's business.

To establish these facts it is necessary to accumulate the total number of productive hours or the total productive labor value expended on all work for the customer during a given period.

The cost of the net material used per pound is shown by the monthly cost sheet, as is also the hourly or percentage rate of expense.

These units may be readily converted into total dollar expenditures, giving the entire cost of the product up to your shipping office door.

To know the cost of particular castings or any class of castings the foundry man must have a record of the actual productive labor, in hours or money, expended on the castings. With this fact established the total cost is figured in the same manner as outlined in the previous paragraph.

In brass foundry work the cost of the net material used will vary according to the value of the different mixtures; otherwise, the general method of figuring is the same as outlined above.

FOUNDRY ORDERS.

The foundry order system should be so designed that the initial entry will by one writing: (1) constitute the permanent office record; (2) advise the pattern shop to prepare the patterns and deliver them to a certain molder; (3) advise the core shop of the number of cores required and to whom to deliver them; (4) authorize the molder to proceed with the work, tell him when de-

livery is required, and provide him with a place to record the number of good and bad castings which he produces; (5) give complete shipping instructions to the shipper; (6) act as a tracer notifying the office of

(1) The date of delivery of pattern to foundry;
(2) Molder to whom work has been assigned;
(3) Date of final delivery of cores;
(4) Date of completion of order by molder;
(5) Final date of shipment.

The foundry manager is in this way at all times in touch with every order which has been issued, and can answer inquiries with the least possible delay.

A system of this kind is so elastic that it permits each foundry manager to arrange it to cover conditions which may be peculiar to his foundry alone. Furthermore, the order system is closely allied to the method of analyzing costs, and warrants careful thought and attention.

PATTERNS.

Every foundry manager realizes the importance of a quick handling of patterns.

To facilitate this work all patterns received by the foundry should be catalogued, preferably in card form.

The catalogue should give a complete description of the patterns and the core boxes, stating the number of pieces in each.

The pattern storage loft should be divided into sections, bins and shelves, and numbered or lettered. On the receipt of a pattern it should be assigned to a permanent resting place in the storage loft, and letters or numbers indicating the location should be marked on each part of the pattern. At the same time the location is entered on the catalogue card.

In many foundries today there is an annual leakage of a great many dollars because of the crude and unsystematic manner of handling patterns. Lack of system here places the foundry at the mercy of one or two men who may happen to remember that such and such a pattern was originally stored in a certain section. Shipments are many times delayed and errors are invited, with a consequent feeling of annoyance and irritation reaching from the manager to the shipper.

Again, what will be the loss to the foundry, measured in dollars and cents, if the foundry should be deprived of the services of the man who carries the information in his head?

With the patterns properly marked and catalogued, the pattern storage loft becomes an automatic machine which may be operated by any employe who can read numbers and letters.

INSPECTION.

Valuable information will be obtained from the proper record

of bad castings. It is always to the advantage of the manger to have a positive record of the relative value of his workmen. This information comes primarily from the inspector or from the employe acting in that capacity.

For this purpose "Castings Rejected" slips are issued by the inspector for each casting lost. These slips authorize the workman to reproduce the castings when necessary, act as a notification to the office to deduct the amount from the workman's pay, if the work is piece work, and finally are so treated in the office that a true record of the value of the workman is obtained.

In times of business depression or internal trouble and discontent, these individual records may be effectively used by the management,

THE CHEMIST.

The importance of a periodical chemical analysis of the metals melted and the product obtained is now so thoroughly recognized that it is hardly necessary to discuss the subject.

The chemist not only keeps the foundryman from getting into trouble in his mixtures, but reduces the costs by recommending that a greater percentage of scrap may be put into the mixture because the metal people occasionally ship materials of more potent chemical properties than called for in your order.

STATISTICS.

The cost department should prepare a set of statistics so arranged that the most important points of the cost and production sheets may be compared from month to month in deadly parallel columns.

These statistics should cover the entire fiscal year on one form, and in addition to data of cost, etc., should record ratio of coal and coke to metals melted, average number of producers and non-producers, average number of days worked, and all other data of importance to the management.

ORGANIZATION.

This subject may be described briefly as the centralization of all work and the authority to do work immediately under the eye of the management.

The management must run the business, or the business will run the management.

GENERAL REMARKS.

This paper is designed to cover in a general way the vital points which have to do with any and all foundries.

In the actual installation and operation of a system there are always local conditions which require individual treatment and consideration, but the skeleton or frame-work is identical in almost every case.

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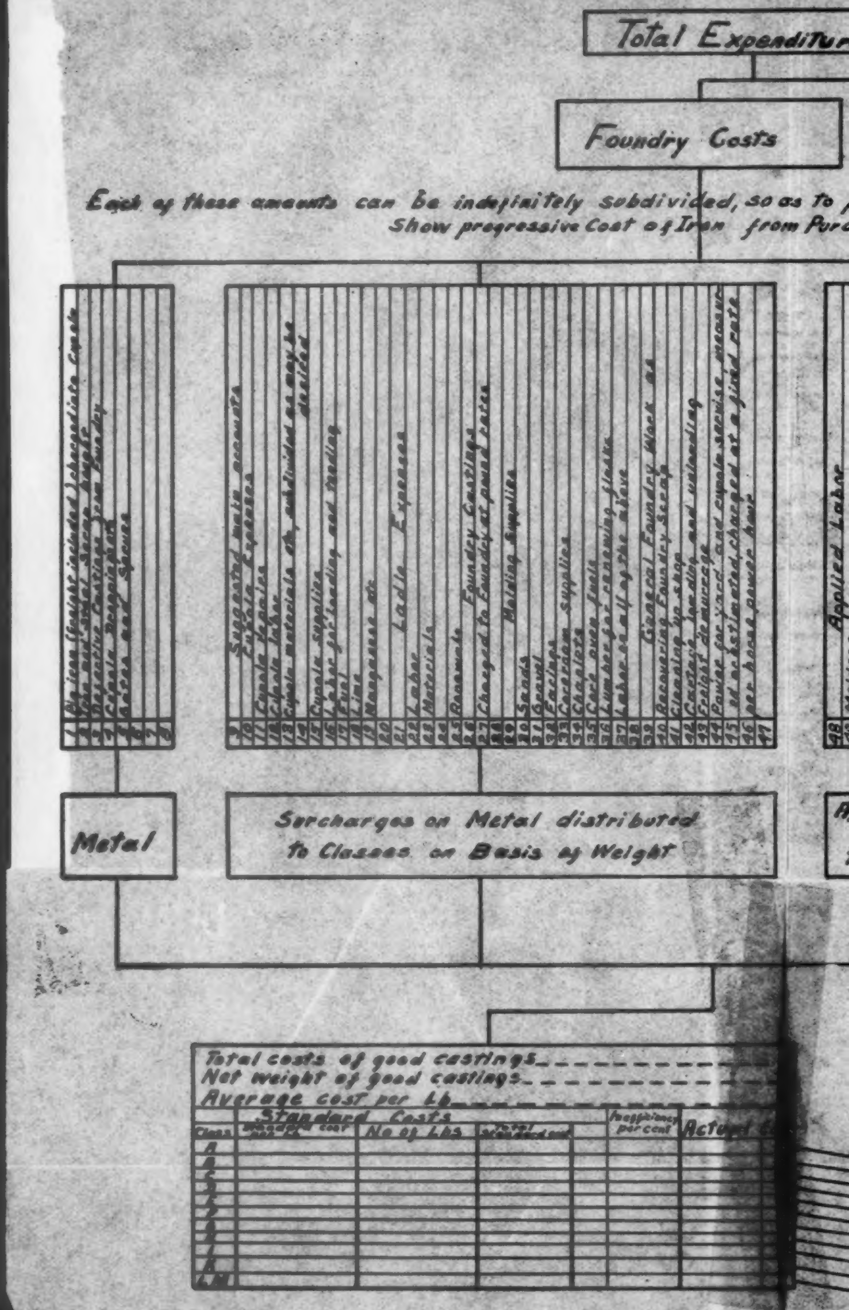
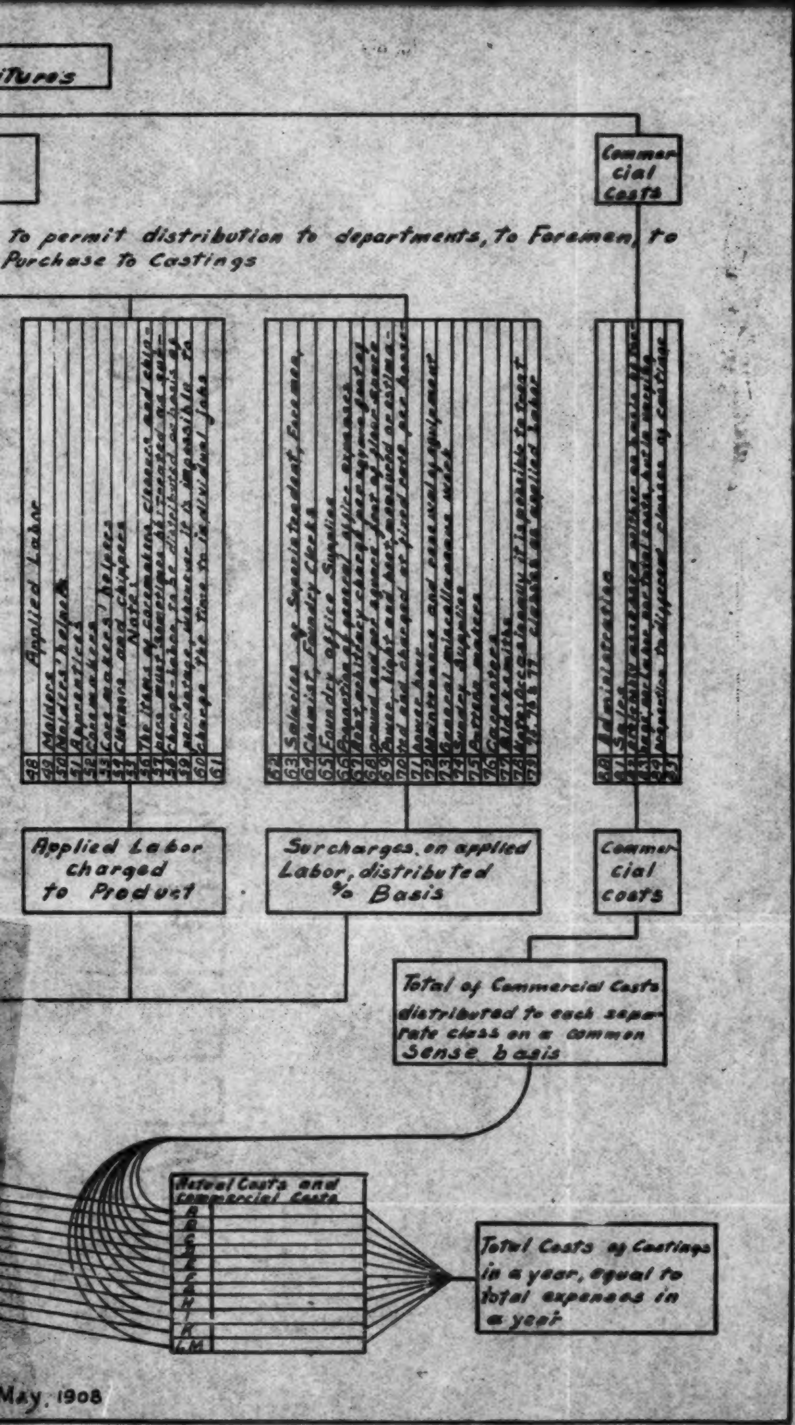


Chart prepared by the Committee on Cost Accounting of the American Foundrymen's Association.

HARRINGTON EMERSON, Stanlard P



...rd Practice Engineer, New York

OXY-ACETYLENE WELDING

BY G. H. TAYLOR, PHILADELPHIA, PA.

With the discovery of the Oxy-Acetylene blow pipe the Metallurgist found an apparatus that at once solved a very difficult problem; namely, a heat producing agent of great intensity, of extreme flexibility and at relatively low cost; nor was the Metallurgist the only one to profit by this invention for valuable applications have been found for it in almost every line of manufacture.

Before going into a detailed description of this apparatus a brief outline of other high heat producing agents will be given.

Probably the first burner of any value was that of Bunsen, using carbureted Hydrogen or ordinary illuminating gas and air. This owing to its relatively low heat was of little value to many operators and so a natural step was to use pure Hydrogen. At once the great value of this was recognized and the Oxy-Hydrogen burner came into general use, more particularly in Europe.

With this flame the autogenous welding of steel and iron became practical, but was limited to work on metals about ¼" in thickness. One of the greatest difficulties lay in the adjustment of the burners for the appearance of the flame changed very slightly with widely differing proportions of oxygen; this of course resulted in an operator having to depend on the appearance of his work to tell him whether or not he was using an excess of oxygen, and a very slight excess affects the strength of the joint enormously.

The electric arc has also been used extensively for autogenous welding and is without doubt extremely valuable in certain lines, particularly to the foundryman, who by its use can readily close up shrinkage cracks, sand holes, etc.

Too much dependence on the strength of an arc welded joint

cannot be made however, for as a usual thing the metal is left extremely hard. In working with the arc care has to be taken not to expose the skin, for the chemical rays are so intense that a very painful *sunburn* can be obtained in from 10 to 15 minutes; hence all operators wear gloves and mask and are careful to deep covered up.

The resistance or Thompson method of electric welding has many advantages over the arc method, there being no danger from chemical rays and an entire absence of the blinding light of the arc. It is distinctly a machine method, however, inasmuch as anything to be welded must be put through a suitable machine.

Another valuable heat producing agent is found in Thermit, but this has little application for commercial work outside of the foundry or for break downs.

In the Oxy-Acetylene process we have, however, practically all the advantages of the previously stated methods, and an absence of their disadvantages, for here we have the intensity of the arc with the flexibility of the blow pipe and an entire absence of dangerous rays.

An additional advantage is found in the chemical nature of the flame, which is composed of an inner cone having a temperature of over 6,300 degrees F., and a relatively cooler envelope or brush composed of Hydrogen and water vapor, which not only protects the heat of the inner cone, but also protects the welded metal from oxidation by preventing contact with the air when in a molten state. When it is remembered that fire brick can be made to melt and run like water the great heat of this flame will be appreciated.

Theoretically, it requires 2½ volumes of oxygen to combine with 1 volume of acetylene, but in practice the burners are designed to supply from 1.3 to 1.8 volumes of oxygen to 1 volume of acetylene and the balance is obtained from the surrounding air. The burners are designed on the well known injector principle, but there are two types at present on the market known as the high pressure and low pressure systems; which means that in one case the acetylene is supplied at a very much higher pressure than in the other. The oxygen in both systems, however, remaining at practically the same pressure.

It will of course be appreciated that where the acetylene is forced into the oxygen stream a better mixture will be obtained

and necessarily a more perfect and economical flame. The high pressure burners have another decided advantage in that they are of much simpler design than the low pressure, so are not so liable to get out of order. Still another and very great advantage is that removable tips of different sizes can be used on the high pressure burners, so that 1 blow pipe can be used properly, on many thicknesses of metal, while in the case of the low pressure system a different blow pipe must be used for each thickness of metal.

The next point which naturally arises is the source and cost of the necessary gases. Acetylene, as is well known, is made from a product of the electric furnace called Calcium Carbide (CaC_2) in contact with water, and in properly designed generators the gas is only produced as needed and no storage holder is required outside of the usual small one which is an integral part of the machine.

As this material is now sold at $3.50 to $3.75 per 100 lbs. and the gas yield is about 4.5 cu. ft. per foot per lb. of carbide, the cost of gas per ft. can readily be obtained.

Oxygen can be obtained from various sources and is now regularly on the market and quoted at 5 cents per cu. ft. It might be interesting to note that in France it is supplied at a cost of less than 1 cent per cu. ft. (guaranteed purity 95%).

By making the oxygen as part of the daily routine of the plant it can be had for less than 2½ cents per cu. ft. in any quantity from 50 cu. ft. to 1000 cu. ft. per day.

To return to the burners. After they have been connected by suitable tubing to the sources of gas, the acetylene is turned on and lighted; the oxygen is then turned on through a previously *set* reducing valve and either (acetylene or oxygen) adjusted until a proper flame is obtained. Owing to the great change in the appearance of the flame, not the slightest difficulty is experienced in the adjusting or in recognizing the proper flame when obtained.

The pieces of metal to be welded, having previously had their edges dressed or beveled off sufficiently to permit the flame to strike the bottom, are set up in the required position and the blow pipe is applied at one point. A very short time after the flame has been applied (2½ seconds for 1-16" steel) the metal begins to run; the operator then holds a stick or wire of the same ma-

terial he is welding, in such a way that in melting it will drop down on the beveled portion of the pieces and so fill up the space. This is repeated continuously along the entire length of the seam. The finished joint then shows an elevation or ridge, caused by the operator melting at each point a slight excess of metal or overloading the joint.

This is done for two reasons—Where the greatest possible strength is required the joint is left as it is and so is stronger than the body metal, being thicker. If a fine finish is desired overloading is necessary, so no hollows or depressions will be found when the surplus is ground or machined off. If properly done it is not possible to detect the joint. So very quickly does the welding progress that the pieces are not even red hot an inch away from the actual welded portion. Not only can all the commercial metals be welded, but almost any combination can be made, such as copper or brass to steel, steel to cast iron, etc.

Aluminum, which has heretofore resisted all attempts at soldering, can be readily welded. So very many applications have been found for these burners that it is not possible to give more than a very few uses; among these may be mentioned the welding of—

Bicycle parts.

Complicated pipe sections.

Auto rims and frames.

Tanks and boilers.

Repair of steam boilers, etc., in position.

Manufacture of safes.

All thin sheet steel construction.

Flanges, T's, Y's, etc., in copper, aluminum or steel tubing.

Fastening or alloying copper to steel, such as copper bonds to rails, etc.

Another and very valuable application of this apparatus is found in the cutting of steel. For this purpose a burner of special construction is necessary and which has in addition to the regular welding flame an opening for pure oxygen under a pressure of 150 lbs.

To cut, the welding flame is adjusted and applied on one edge. As soon as the metal has commenced to melt at that point the high pressure oxygen is turned on and the molten metal is instantly oxidized and is blown away; the burner with the oxygen still flowing is then moved along the line to be cut and the oxidation progressed continuously. Should the burner be moved too fast, however, the cutting stops. The operator has then to bring the metal up to the melting point again, when the oxygen is again turned on and the cutting continued.

To give some idea of the speed of cutting it might be said that it is possible to cut steel bars 2"x2" in 20 seconds, and 1/4" plate at the rate of 45 seconds per ft.

NEEDLESS FOUNDRY WASTES

By HARRINGTON EMERSON, New York City.

If in the operation of a foundry any dollars are spent needlessly, the loss is a foundry waste. Wastes of this kind are very common and easily overlooked. In the discussion of the molding machine before this Association yesterday, one of the members spoke of the desirability of equipping the foundry in such a way that operations could be carried out more conveniently, therefore less expensively. Another speaker, with some feeling, remarked that a policy of this kind would put sixty percent of the foundries of the country out of business.

There are, however, many wastes occurring in foundry operations which it would cost next to nothing to eliminate or at least lessen, unless one puts a price on a little thought and observation. If a founder for a few days could forget all about iron and molding, as well as sales, and go through his own foundry with the same keen, alert, and awakened critical attention that the stranger who is not a founder sometimes displays, he could add unexpectedly to his profits and to his pleasure in the business.

In neither a technical nor scientific way, I shall simply give you a few examples of the preventable losses and wastes I have noticed in visiting various foundries throughout the country from the coast of Maine to the coast of California.

1. Losses due to bad cost accounting. In one foundry making part of its product for the trade and the balance for its own machine shop, all the costs during the month were added up, divided by the total weight of castings delivered, and the conclusion arrived at that the cost of castings per 100 pounds was about $2.50. On the basis of this system of cost determination, contracts were entered into to supply certain firms with castings at $2.75 per 100 lbs. An actual subdivision of costs in this

foundry showed that some castings cost as low as $1.50, and others as high as $10.00 per 100 lbs. The customers with the flat rate contracts ordered their cheap castings elsewhere, actually felt aggrieved, and properly so, that this firm should presume to charge $2.75 for what other foundries supplied at $1.75. They, however, rushed in all their small and intricate work which cost from $3.00 to $10.00 per 100 lbs. and paid only the contract price of $2.75.

2. Losses due to bad design. A rail road foundry without any cost system charged for big cylinder bushings $4.00 per 100 lbs. These bushings were made very thick, nearly two inches, so that the rough casting weighed about 1,700 lbs. Machining brought the weight down to 375 lbs. which took about a week of an expensive man's and expensive machine's time. The cost of the finished material and labor was about $75.00.

Another firm offered to supply the finished bushing at $50.00. This firm made the rough casting weigh 600 lbs., machined it in a day at a total cost for material and labor of $30.00. There was between the two operations an actual waste of $45.00, and it makes no difference who paid it, it was there.

3. Unnecessary work. Another combined foundry and machine shop had over 300 patterns for box covers. Had they been of standard design, 20 would have answered. Instead, therefore, of working up a small quantity of stock from 20 patterns, the foundry was more or less busy in getting out odd orders for box covers, and many were made for stock which were never used.

4. Hard Iron. A foundry never analysed either its iron or coke. The purchasing agent bought what was cheapest. On one occasion he invested in a ballast cargo of inferior Scotch pig, high in sulphur, and when analysed, the coke supplied was found to run 3% in sulphur. A change to better pig iron and to coke with less than 1% in sulphur reduced machine shop expenses over $18,000 in a year. If it had been necessary the better coke would have been cheap at $20 a ton, but actually the better coke cost $0.10 a ton less than the poorer article. In this case $15 a month invested with a testing laboratory returned a dividend of $1,500 a month.

5. Badly directed labor. Within the period of two weeks we had occasion to compare two foundries, both in the middle West, both ranking very high in their respective fields. One foundry turned out its finished castings for less than $1.40 per 100 lbs.,

all material, labor, and overhead charges included, except depreciation and interest on the investment. At the other foundry the total cost of finished work was over $3.00. The work was so different in character that these figures have little comparative value, but as to entirely comparable operations the labor costs were only one third as much in one foundry as in the other. This was not because the men did not work hard, in fact were to the limit of human endurance in the less efficient shop, but they worked hard to no purpose. On both charging floors the charges came up in trucks. In one case trucks, tracks, cupola doors, as to height and location were so adjusted that one man easily charged direct from truck to cupola, while in the other case the same combination was so awkwardly adjusted that it took three men to do the same work, passing the pig and scrap from one to another. All labor efficiency in these two foundries ran on about this same comparative basis, work costing three times as much in one as in the other.

6. Curtailment of output and increase of expense owing to vicious system of paying for work. In a foundry men were paid by the piece. The management imagined that in this way they had attained a fixed cost. A checking of all the conditions showed this not to be so. Nearly all the molders had set themselves fixed outputs. They felt that if they earned more than a certain amount, their rates would be cut. By limiting themselves some worked very fast for a while and then dawdled, smoking, talking, visiting neighboring saloons. Others worked with a fatiguing deliberateness. Others found it easier to average their operations by molding many pieces carelessly with many rejections on inspection, rather than to mold fewer pieces perfectly.

As a consequence not only was the output generally curtailed, but there was a very large amount of remelt, which added to the amount of sulphur, made more pig and less scrap necessary for proper mixtures. These various forms of losses added about $0.10 a 100 lbs. to the cost of good castings. As the foundry turned out over forty tons a day, the added cost amounted to $80.00 daily.

7. Disagreements between employer and employee. This is perhaps the greatest waste of all. This ought not to be at all. Clear thinking and clear statements would in many cases pave the way for reasonable concessions on both sides. Three out of the four elements that make into labor disputes, are generally so jumbled together that it is like the fighting of two knights, in the old fable, each looking at the same shield from the opposite sides. One said it was gold. The other maintained it was silver. And so they attempted to settle the job by cutting each other's throats. The shield actually was gold on one side and silver on the other. The three elements that enter into a labor contro-

versy, and that ought to be kept entirely separate are

(a) Rate of pay per day.

(b) Standard cost of output.

(c) Varying efficiency of the workers.

Every worker naturally wants and ought to have the highest rate of pay which circumstances or combination will permit him to exact. These rates of pay cannot be immutable. They will fluctuate up and down and may not be adjusted without more or less friction and controversy.

Both parties are equally interested in low cost of output. The lower the cost, the greater the market, the more work there is the higher the wages can be. If finally standard costs of output can be so arranged that as labor efficiency reduces cost, labor is paid a higher rate, then both employers and employees can rejoice as higher efficiency receives higher pay. On a very large scale this solution of labor compensation has been tried out and with entire success. The men receive in any case a standard day rate of pay. If there was shortage of work, the hours were shortened, days were omitted or men were laid off. A standard a fair cost was put on every item of output, this output being what a good man working faithfully but without undue exertion, under perfect conditions, ought to deliver. If this output were reached as to the average work of a month, the worker was rated at 100% standard, and received a premium above his day rate. This was virtually a stipend paid him for acting as his own foreman. If the worker did better than 100% standard, all the gain in time was his own. If he did less he was still certain of his day's pay.

It is nonsense to pretend that in any plant the good men are not generally differentiated from the poor ones. Since this is the case it is absurd not to recognize the fact scientifically and fairly. Efficiency of the worker has nothing to do with the agreed upon rate of wages. The reward of efficiency merely gives to the individual worker the whole of that part of the reduced cost to which he is entitled. He leaves to the employer the gain due to lessened equipment charges, lessened overhead charges, increased output.

With a system of this kind, the net profits of a plant have increased several hundred percent, the net ability of the worker to save above living expenses has also increased several hundred percent, and both realized that the lower the manufacturing cost, the higher the individual worker's earnings.

An old fashioned foundry which eliminates useless wastes will often find itself able to compete successfully with the large modern foundries. We all know that a good racing pony can run 100 yards faster than a race horse. 100% efficiency in the small plant, however elementary its facilities, will produce cheaper work than 60% efficiency in a large fully equipped plant. It costs very little to eliminate most of the wastes that occur.

CUPOLA THERMICS

By S. H. STUPAKOFF, Pittsburg, Pa.

In his studies on the reactions going on during the melting processes used for making Cast Iron, and more particularly the thermic conditions, the writer has had occasion to analyze practically all that has been written on the subject. The result has been much that has impressed him as valuable, and again much that is quite erroneous.

A conscientious observer is placed in an embarrasing position by being compelled to select his basis of calculation from data which is very conflicting. These figures have been handed down to us by most illustrious and truthful scientists, but are nevertheless erroneous. If these results of scientific research differ, the blame should not be cast altogether on the observer, for it is rarely the case that anything but the minutest care and most reliable methods are employed in such work. Beyond the personal equation, errors are principally due to defects in the physical measuring instruments used for the work in hand. As in all things, there has been a continual advancement in the design and preparation of these instruments, which are being made more sensitive, and accurate year by year. The most modern scientific instruments—not the cheapest—eliminate previous inaccuracies to a remarkably high degree, and hence we now have data which throws a somewhat different light on some of the occurrences in the cupola from what we have heretofore believed. Thus, the melting point of cast iron taken by one writer at 2,600 degree F., and that of the metal as it leaves the spout, at 2,900 F. is evidently based on blast furnace temperatures and not those of the cupola. This is not surprising, as

we even find the melting point of cast iron given in Rankine's Steam Engine, edition of 1878, at 3,479 degrees F.

Dr. Moldenke has rather conclusively settled this point in his work on the melting point of Cast Iron, his observations giving the range as between 1,990 and 2,280 F. These values are evidently not far from the actual truth, and may be accepted until their author sees fit to repeat his investigations with later and more improved apparatus. The conclusions drawn from Dr. Moldenke's investigations are that other things being equal, the larger the percentage of combined carbon, the lower the melting point. Remelting iron lowers its melting point. Ordinary iron foundry mixtures melt between 2,100 and 2,150 degrees F. and the temperature in the ladle under normal conditions is between 2,150 and 2,185 degrees F. These figures are the result of numerous tests made by the writer. The temperature of the metal running over the spout is practically the same as that in the ladle. There is little chance in ordinary foundry practice for the iron to get much hotter in the cupola than the point at which it melts, and it may be added, that cooling in the ladle takes place much slower than is generally supposed. Further, a difference of but one hundred degrees in the temperature of a molten mass of iron is far greater than would be ordinarily admitted, and certainly cannot be properly estimated by the eye. A suitable pyrometer alone will measure it accurately.

Another mistake introduced into calculations is the selection of the factor 0.13 for the specific heat of iron. This is Regnault's value, rounded off, and is as reliable as any, if used as given by this great physicist. It holds all right between the freezing and boiling point of water, but is of little value in dealing with temperatures of 2,000 degrees F. It is well known that the specific heat of solids increases with rising temperatures, that is it requires a greater quantity of heat to raise a solid substance one degree in temperature, at high temperatures, than it does to accomplish this lower down in the scale of temperatures.

We have no experimental data on the specific heat of cast iron at high temperatures. A complete series of tests on this point is still wanted and a great desideratum. And when these tests are made, for foundry purposes it were better to take a typical gray and a typical white iron for these investigations than pure iron only. At the present time we have some re-

sults by Harker and Oberhoffer, who give a complete analysis of their iron used (nearly pure), and who experimented up to about 2,700 degrees F. While these results are not altogether what we want, we will use them for the purpose of the calculations given below, and thus get at least approximate results for cast iron.

There are several good reasons why the specific heat of cast iron should be higher than that of pure iron, or for that matter of steel. The figures below are offered in proof—it is believed for the first time. Reliable data inform us that the specific heat of all impurities in cast iron is higher than that of pure iron itself. It is also known that the same quantity of heat is required to heat an atom of all simple bodies up to the same point. Hence, if a substance consists of several ingredients, which singly represent a larger proportionate value than equal portions of one of its parts, the mixture must represent a larger sum total. The following example of a hypothetical case will serve to show what is meant.

Analysis; in parts.		Atomic Weight.	A equals No. of Atoms.	Sm equals Mean Sp. Heat.	Product of A by Sm
Carbon	4.00	12	48	.214	10.27
Silicon	.50	28	14	.26	3.64
Manganese	.30	55	16.5	.122	1.49
Phosphorus	.18	31	55.8	.190	10.60
Sulphur	.02	28	.56	.202	.11
Iron	95.00	56	5320.	.114	606.48
Total	100.00		6454.86		732.59
			divided by 100 equals 64.5486		divided by 100 equals 7.3259
Whereas pure iron—		56 equals	56.0000	.114 equals	6.384

The result shows that whereas pure iron has an atomic weight of 56, the example above corresponding to a cast iron, would run about 64.5, and that the mean specific heat for each, at temperatures from 32 to 212 degrees F., if known for the simple components, can easily be calculated out by simple arithmetical proportion:

6.384 : 7.3269 :: 0.114 : 0.138

This value corresponds admirably with that given by Bystrom (0.12954), who has carried on his investigations on the specific

heat of cast pig iron up to 572 degrees F. for which point he gives 0.14070. He, however, does not give the analysis of the iron experimented upon, and it should be understood from the foregoing that an even greater discrepancy could be accounted for by a comparatively small variation in the percentage of carbon.

It may not be out of place to mention an additional factor which comes into play here. The heat of chemical combination. Particularly when this method is applied to other grades of pig iron, such as the white, mottled, etc. Now Harker and Oberhoffer have found that the specific heat of iron increases in about the same ratio up to within the region of the critical point, or about 1,382 degrees F. After this it remains practically constant. Using this fact, we have the following according to Harker:

0.114 : 0.130 :: 0.160 : 0.1825, and according to Oberhoffer

0.114 : 0.130 :: 0.160 : 0.190, as the specific heat of our cast iron at or near its melting point. Assuming that this falls within the neighborhood of 2,150 degrees F. for the case under consideration, we find by simple multiplication of the temperature in degrees C. (instead of F.) by the mean specific heat, the heat of the iron in Calories. And by further multiplication by 1.8, the equivalent in British Thermal Units. Hence

Minimum							
1150 x .167	equals	192	Cal.	x 1.8	equals	345.6	B. T. U.
Harker							
1150 x .1825	"	210	"	x "	"	378.0	"
Oberhoffer							
1150 x .190	"	218.5	"	x "	"	393.3	"
*Regnault (old)							
1150 x .130	"	149.5	"	x "	"	269.1	"

The highest one of these values approaches apparently most closely the true state of affairs, and until further results are gotten, it will be safest to make use of this data. Moreover to round off our calculations, we may change 393.3 to 400 B. T. U. and be within safe limits.

We come now to a third factor which has been used for cupola heat calculations. 233 for the "latent heat" of Cast Iron. Careful search has failed to reveal the origin of this particular

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*J. W. Richards considers Pinchon's determinations as the best. They were made before Harker's as well as Oberhoffer's, and the latter has evidently used the better methods and obtained the best results. Pinchon's determinations were on soft Berry iron. Richards gives the formula for the mean specific heat zero to t, (t being about 1930 degrees F.) as

0.19887 minus 23.44 divided by t

and this gives for that temperature 0.19618.

According to the same authority there are absorbed between 1,112 and 1,328 degrees F. as latent heat, 5.3 Calories, and between 1,830 and 1,920 F. 6 Calories, while at the point of fusion 69 to 70 Calories are absorbed. The total heat in the liquid iron is 235.6 Cal., or total 316.9 Calories equals 570.42 B. T. U.

value. It is evidently wrong. If we ignore all figures given by experimenters on this point, we will not go very far wrong by asserting that it must be less than that of ice. That is less than 79.25. Some authors give it as 69 to 70 for pure iron. The tables annexed to Whiting's Experimental Physics give for the latent heat of fusion of gray and white iron respectively the figures 25 and 34, both being quoted as questionable and no authority being mentioned. It is possible that these figures are too low, but there seems to be no doubt that the latent heat of cast iron as a mechanical mixture or as an alloy, must be below that of pure or nearly pure iron. The molecules of different substances intermingled (not chemically combined) do not oppose separation from each other with the same tenacity as the molecules of a simple substance. In other words, there exists a greater inertia between the individual particles of a single simple substance, than between the different particles of different substances, and the quantity of heat which is required to overcome this inertia is the smaller one in the latter case.

Placing these different values side by side for comparison, we have

AUTHORITY.	DESCRIPTION OF MATERIAL.	LATENT HEAT.	1 CAL. EQUALS 1.8 B. T. U.
Whiting	Gray Iron	25 Cal.	45 B. T. U.
"	White Iron	34 "	62.2 "
Gruner	Cast Iron	46 "	82.8 "
Campbell	Steel	69 "	124.2 "
Richards	Iron	70 "	126.0 "
Bird	Cast Iron	140 "	233.0 "
Approximate	Mean of first five	49 "	88.0 "

If we should add this last value to the total which we have found for our iron in the solid state at the melting point, we would obtain

393.3 plus 88 equals 481.3 B. T. U.

and this is not very far from Ledebur's figure of 250 Cal. or 450 B. T. U. as the total heat in melted iron. Mr. Bird's figure (603.5 B. T. U.), it would seem, for the total heat in melted cast iron would exceed actual conditions by at least 25%.

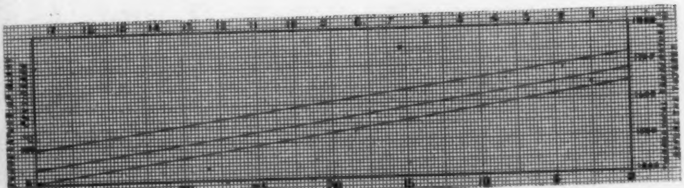
It has been assumed that iron is heated 300 degrees above the melting point in the cupola. This is almost impossible under normal conditions, as little time is given ordinarily for the metal to accumulate in the bottom, before drawing off. More-

over any heat gained from the melting zone, after this has been passed would be by radiation downward. If anything there is a loss of heat, as the temperature of the coke below the tuyeres is not as high as at the melting zone. It is an entirely different matter in the open hearth furnace, or even the air furnace, where conditions prevail that make it possible to heat the mass considerably beyond the melting point. But even here the temperature will not be permitted to approach 2,900 F. or within 500 degrees above the melting point of the metal charged.

The heating value of the coke used in melting naturally depends in the first degree upon the fixed carbon content, which varies from 85 to 94%. Then we have the sulphur running from 0.75 to 2% and sometimes over. 13,000 B. T. U. is given as a fair theoretical heating value for perfectly dry coke. In practice, however, we are dealing with a fuel containing from 5 to 10% moisture. This alone cuts down the heating value of the fuel from 12,350 to 11,700 B. T. U. per lb. But even more is lost as the moisture must not only be deducted, but heat is actually lost in evaporating and heating the moisture up to at least the temperature of the gases leaving the cupola. These gases may safely be assumed to be between 800 and 1,600 F., and will more usually be found to run between 1,000 and 1,200 degrees F. This holds good for the moisture in the upper charges of the fuel, the greatest part of which is undoubtedly evaporated by the ascending hot gases; whereas a portion of the moisture of the lower charges may be heated to a higher degree.

We are thus losing by heat in moisture of the fuel carried off by the escaping gases at 1,112 F., per lb. of coke, from 180 to 360 Calories, or from 325 to 650 B. T. U. (roughly). We have therefore not more than 11,000 to 12,000 B. T. U. net heating value of the fuel used at our disposal. And even this can be obtained only by perfect combustion with the correct theoretical quantity of air, which every body knows is not possible in practice.

The necessary amount of air for the combustion of one pound of coke is given by Baird at 12 lbs. This equals in round numbers 150 cu. ft. per pound of fuel, and it may be the correct theoretical quantity of *dry air* for the particular brand of coke used. But we never have such ideal conditions. Our atmos-



For insertion between pages 86 and 87.

phere is always charged with more or less moisture, which must be duly taken into account in making our calculations, in order to arrive at an approximately close result.

The quantity of air used, and its moisture influences the efficiency of the melting far more than all other disproportionate agencies combined. Quoting from Prof. Richard's admirable book on Metallurgical Calculations, the theoretical temperature before the tuyeres with a blast at 104 degrees F. may vary as much as 423 degrees F. from a change in the moisture from dryness to saturation. This variation has been graphically illustrated on the following diagram, in which the base line represents 1,400 degrees C. equals 2,552 F. The horizontal distances are given in grains and grammes of moisture, and the vertical distance variations in the maximum theoretical temperatures before the tuyeres.

It is understood, of course, that the above are maximum theoretical values, resulting from calculation, which cannot be obtained in the practical running of shaft furnaces, but which should be approached as closely as may be. They may prove at any rate for the purposes of our calculation that there is not much likelihood of heating cast iron in the cupola up to 2,900 F. as has been held.

This does not by any means exhaust the subject, but is given in the hope that further thought be concentrated on the thermic calculations for the cupola. With these figures as sort of guide posts, the practical man can inform himself better with a view of improving his methods, perfect his appliances, and by studying his fuels, etc., learn how to eliminate losses and achieve more satisfactory results.

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OUR INDUSTRIAL SUPREMACY

By G. W. J. SPENCER, Philadephia, Pa.

As a nation we are engaged in business for maximum profit, for the purpose of effecting self and race preservation and furthering those principles which will establish perfection and permanency in all our institutions. In its pursuit we have been regarded from abroad as resourceful and enterprising, but recently, the technical press has brought forth articles savoring of alarm and enumerating our short-comings in supplying and maintaining an adequate supply of competent workmen to cope with the increasing ability and efficiency of the product of Germany's technical system of education. The proceedings of the American Society of Mechanical Engineers is an important contributor to the discussion of this subject, and it is gratifying to observe the interest and the papers which were prepared for this meeting and the work of the Committee of Industrial Education.

Our future endeavors must not be limited by that of the past and the gains made, but it is suspected that the gains we have made are of a more temporary character, as we have

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Note.—A contribution subsequent to the reading of the papers on the Molding Machine, The Winona Technical Institute, Prevention of Accidents in the Foundry and the Reports of the Cost Committee and Mr. Kreuzpointner on Industrial Education. Prepared by request of the Secretary.

not built upon the thorough conscientious lines of our German competitor, who has not had natural resources that we possess and which we have hitherto regarded as unbounded. In line with the preservation of these natural assets there is ganization to manipulate and convert these resources.
a constantly pressing need of a more efficient and stable or-

The need is now so apparent as to promote a closer study of the efficiency and methods of our competitors and a closer prenticeship courses have assisted the journeyman operator. Our study of conditions as we find them surrounding us.

The work already done and under way to eliminate the extravagances destined to deprive posterity of the valuable assets of nature is indicated to some extent, by the work of our Association and its able individual members, and the enormity of the depletion of these resources is startling in the extent of the figures that can be quoted for the coal, lumber and other raw materials.

The character and uses of material to determine the intelligent adaptation to meet requirements, which is being carried on under Government auspices, technical school laboratories, and numerous educational bodies in their especial provinces, are accomplishing, in their particular direction, great good, as has work of this Association for the foundry industry, upon which nearly all our manufacturing interests are dependent for shaped material; giving to the individuals engaged a more exact science and direct and economical method.

We are about to employ material with more definite knowledge, adapting the cheaper when adequate to the work to be performed, and the more costly where necessary, with a minimum loss in waste in its preparation.

It remains then to perfect our men and to promote their efficiency, the improvement of character and the elimination of false moves and wasted energy. The wilful waste of our timber tracts has been offset by the substitution of iron and steel, but the waste of fuel in its preparation has continued. The neglect of development of our workmen can only be offset by intelligent preparation of the young men in the hands of our practical, as well as technical educators.

Our endeavors have been concentrated to rapid production,

and low cost has been for some time our objective. We have not always endeavored to make the best, and though it is claimed of our new product as cheaper and better, quality has in few instances been sufficiently considered, and the man has been given no thought.

It is interesting to note how we may concentrate on one element of the problem. In the discussion of the paper on Moulding Machines is shown the benefit to labor by the introduction of machinery in various fields. The promotion of our artisan from work requiring low grade application to a lesser number of skilled operations, the transferring of the work requiring a lesser degree of skill to the uneducated from abroad, and taking our unburdened worker to a plane of enlightenment and the dignity of directing the laborer and the machine. The Moulding Machine in its present state has not fully obtained its purpose, its design has been to make moulds and much time and ingenuity has been spent in determining if they shall be rammed as before, or jolted or squeezed, giving little study to the development of adjunct contrivances or of changes of method in shop management to take care of the increased amount of materials, handling and disposition.

No more can be expected in the education of our artisans in future than in the past, if trained by those with self acquired, practical knowledge alone, even though he is meeting and mastering commercial problems daily and improving his skill by intercourse with current technical literature and meetings with associations, while the technical educator, by his academic training possesses the power to discipline and impart, he in his time rarely has had an opportunity to acquire the experience to become familiar with the requirements of a successful commercial executive. We must have concordant action of both, and every student will be just that more efficient, as will our commercial and technical instructor co-operate.

The value of this requisite has been recognized for some time as a student, and in the course of daily solution of problems confronting shop operation. The best work thus far accomplished in our trade and technical schools is where there has been an attempt in the direction of actual practice, where the head and hand has been trained simultaneously and in which

knowledge is applied as it is acquired, with a clear conception of the requirements of the commercial world.

These endeavors have been successful, for we have the statement of one foundryman, who has set up three times as many moulds as he has been previously able to do, but his journeyman does not take kindly to becoming an iron horse, handle all the sand, the moulds away from the machine and carry the iron. This is an illustration of concentration referred to above.

It is up to the machine manufacturers to finish his invention, to provide the necessary attachments, or adjuncts to cope with the new conditions created. It is often found in the applicaion of new devices and changes of an existing method of management that their introduction creates new conditions relating to the changes and having a bearing on the success of the whole and which must be treated at the same time that changes are made, if possible to discern their nature, or very promptly after they have evidenced their existence.

In justice and equity a man cannot be expected to produce three times the former output for the same pay, nor to accept less pay over the increased work, simply because the moulding machine maker claims to eliminate the element of skill by means of his contrivance, and perhaps the man may not be able to do it. The limit of his productivity being his physical endurance, and his longevity depends to a large extent on the rate of expenditure of this endurance.

Would it not only be wise, but timely, after devoting money and energy in developing and exploiting the machine and giving consideration and some action to the elimination of the squander of our natural resources, to give some thought to the human element. The physique and mentality of the boy is the material for which we are preparing methods and means of education, and with which we are to build up our industrial supremacy, and as like produces like we should be concerned in the welfare of our men by helping them to help themselves, to earn sufficient in a reasonable day's labor, to rear and give preliminary education in a reasonable degree of comfort while being likewise themselves. This condition will obtain more and more as our manufacturers come to regard labor in its true value, in turning their capital to profit.

There is a source of income to which it is believed among

all our industrial problems less attention has been given than to the reduction of pay. It is the reduction of costs, by the elimination of waste, not only of materials in its selection and working, the unrecoverable value of lost efforts, false moves and wasted time, which by orderly systemization, instruction, proper equipment, maintained to run smoothly and without interruption, kept continually supplied with work, all contribute to a real reduction of costs. This mainly by working the investment to its maximum capacity, while the labor may profit from this increased production, which results in a higher wage scale and low actual labor cost per unit, the cost will continue to be lessened as the production is increased. This is a more substantial gain than by any method aimed to get something for nothing.

There is another phase, in the commercial end, which has been already referred to. If we will manufacture to attain superior quality and seek the market desiring quality, the standard is raised all along the line and renders more substantial every factor entering into the industry. We will cease to permit the Sales Department to obtain trade by cut prices, having given products of merit and their ability to command it. The Manufacturing Department will not be exhorted to cut the manufacturing cost ten cents to enable the commercial end an excuse for cutting off a dollar. The Shop Superintendent and his staff will no longer design to cut pay rolls nor to double outputs at one half the wage.

It would not be amiss to have our labor regard the employer as the means of his being able to turn his energy to profit and that he is utilizing his employer's finances to effect the same. When we increase capital investments, install apparatus, requiring repair, maintenance and replacement, utilize the services of expert executives, the operator must understand that there is a certain earning to be derived from this investment, and that the employer is not enjoying all the benefit of the increased output which is manifested. This will come with the enlightenment he will derive from industrial education. The papers and discussions of education work indicate that some good work has been accomplished and that the serious attention given to providing a future supply of skilled workmen has evidenced a corresponding benefit. Too much emphasis cannot be directed to

the necessity which is more and more manifest of co-operation in the efforts of the purely practical and the technical educators.

We are well equipped to turn out engineers and our apprenticeship courses have assisted the journeyman operator. Our need at this time appears to be for the executive midway between the two, lacking none of the essentials relating to the commercial end. This product will be realized when the education has been carried out combining the technical and the practical along the lines of work prescribed in the main by one experienced in meeting the demands of business, embellished by the analytic and guiding ability of the purely academic teacher. No system with the preponderence of either or omission of the one will furnish the breadth of ability and intelligence which we of necessity are seeking.

There has been no desire to dwell upon the ethical side of the question, not that its value is deprecated in analyzing the difficulties with which we are in daily contact. There is no doubt that mechanical development has had its effect sociologically and that there is a mutual dependence between the two. The problem has been viewed from a viewpoint of experience in works management, and a study of a large amount of literature upon the subject, having been preceeded by technical education and service in various departments of the shop; from the bench to the executive desk where every problem, no matter how small, has been studied from the standpoint of the worker and the employer. The interests of both are to be served if the organization is to move forward with substantial advances.

INDUSTRIAL EDUCATION AT THE WINONA TECHNICAL INSTITUTE

By PROF. E. A. JOHNSTON, Indianapolis, Ind.

FOUNDRY WORK.

Having now completed our second year's work, graduating 8 students in foundry-work, we are in a position to know to a great extent, what can be accomplished along this line.

Our aim at the start was to produce with two years of training, men who would be just as practical, produce just as good work, and have just as much speed as the Journeyman with many more years experience; coupled with this, enough applied theoretical and technical work, we felt would produce the highest efficiency in our graduates in carrying along foundry operations. Men trained in general foundry work, and not specialty men, was our purpose.

We have demonstrated that this is possible, as has been shown in the work produced in a commercial way for a large number of firms in Indianapolis, also in the general knowledge of foundry work at the completion of the course. This is verified constantly by letters from these firms. Understand that these were not simple castings but were produced in large quantities.

In order to bring about this result it became necessary to

have a variety of commercial work; without this we could accomplish very little along practical lines. The castings that we are now producing are as follows: Steam Engine work, Electrical, Drop Forge, Canning machinery, Brick machinery, Air brake work, Automobile, Gasoline Engine, Steam pump, besides the jobbing work that we get due to our reputation for producing good castings. This gives us the required variety.

Methods pursued in training the student in foundry work are as follows:—

Upon entering the student has explained to him the rules which govern the department, time card methods, etc., after which he has explained to him elementary foundry terms, their meaning, etc., Foundry work, what it is, production of castings, requirements in castings, etc. Green sand molding is then taken up and explained in detail. Molding sand for green sand work, what composed of, why bond is necessary, why porousness is necessary, the grades of sand and their use in the various kinds of work, light, medium or heavy.

TEMPERING SAND: At this stage the student is placed on a green sand floor, with a dried out heap of molding sand, the tempering is explained to him and he is not allowed to proceed until he masters this part of the work.

After this has been done he is given a course in molding in green sand, a set of exercises in which are embodied all the fundamental principles of ramming, venting, jointing, use of runners, gates and risers, setting and relieving vents on plain vertical cores, horizontal cores, irregular cores, securing the sand by means of gaggers, etc., use of split patterns, etc.

The student is shown how to produce the mold for the first exercise, after which he proceeds with this same exercise on his own resources until the mold is completed. The mold is then examined and if correct he is allowed to go on, if not he is required to repeat the operation, after he has received required instructions on the details which he had overlooked. After completing this course of exercises the student is given commercial work of a simple form in green sand, and is allowed to go on according to his own ability with the aid of instruction, until he gets through the variety of light and medium work. He is then placed on the core bench under a more advanced

student and remains there until he becomes acquainted with mixtures, methods, etc. for producing cores. After this he is placed on heavy work in green sand under a more advanced student in this line, and finally is placed on a floor by himself. He then passes on to the dry sand work in the same way, and then on to sweep molding.

From here he goes to the cupola, again under an advanced student, and from this to the molding machines, finishing up the first round with enough time in the celaning room to acquaint him with methods used in cleaning castings. Until the student has mastered one stage of the work he is not allowed to pass to another.

From this stage he again is placed on a green sand floor and is given a general run of work, after which he is placed on the core bench in charge of this department, then on the heavy work in green and dry-sand and then in charge of the cupola, then again back to molding.

Finally he is given full charge of the shop with the responsibility of not allowing productions to decrease, checking out patterns to the men, obtaining the weight of the heat, determining the mixtures (by analysis,) and charges etc., in fact has control of the entire production.

This is an outline of the practical course in which the student averages 7 hours per day for two years. Coupled with this the student is given 8 hours per week in applied foundry chemistry, and 4 hrs. in mechanical drawing, besides shop talks each week.

The shop lectures cover all the applied technical work. Work commences at 7 o'clock in the morning and continues until 6.30 P. M.

The shop is run on a commercial basis giving exact commercial conditions, at the same time being self supporting, and also allowing the boy to earn while he learns; by this method any worthy boy with an eight grade school education can take this course and pay his expenses while at school.

While we have accomplished a great deal along this line of work, we expect to move right along and develop still further, and make the course more complete, if possible.

Note by the Secretary.—At the conclusion of the above

paper, Prof. Johnston gave a series of illustrations with the lantern, elucidating more clearly the above course in Foundry work. Prof. Johnston will be glad to send the full description of the courses given by the Winona Technical Institute on application.

THE CONVENTION IDEA

By E. H. MUMFORD, Philadelphia, Pa.

Why do we attend conventions? Is it to have a good time? If so, we can all think of ways of having the same kinds of fun nearer home. Is it that we may meet our friends and form new acquaintances? That is admirable, but church sociables and political meetings would not take some of us so "far from the Bowery."

Some of us come to advertise, but there would be no object if only advertisers came. Still, with the two purposes—to show and to be shown—inhabitants of other States than Missouri expatriate themselves at June Conventions; and from those who come to see and those who are sent to see for those who cannot come themselves are recruited the fundamental motives for conventions. The advertisers or supply men simply bring material things for very material and worldly reasons. It is by a study of the deeper reasons for the gathering of men in conventions of specialists that we may get at the fundamental idea of the Foundry convention and, possessed of this, unconsciously make the convention ideal.

No man, be he ever so able, can accomplish his complete work in the world without suggestion or advice from other men's experiences. The "Cogito, ergo sum" of Des Cartes, expresses the total of a lone individual's accomplishment. All other knowledge is absolutely relative—based on a man's experience—acquired through association with his fellows.

In an absolutely open country or in a level forest it is said that a man without a compass travelling alone on a cloudy and still day moves in a circle and returns to his starting point

with nothing accomplished. It is evident that if in that country there were an eminent land mark, such as a very tall tree or a mountain, as long as he held such a reference point in sight or felt the slope to the mountain under his feet he, by knowing where the tree or the mountain was, might by so much regulate his course and his "circle" would be distorted so that he would make a little advance, tho' with only one mountain or only one tree his chances of arriving at any destination would be infinitely small.

I am speaking of a wide-awake thinking man. Nothing can guide the man who during his trick at the wheel slumbers for a moment, loses his star, and calls the skipper on deck to give him another because he has passed that one. Such a man can't hold a course any way and will always work for cabin boy's wages.

But the men who travel hundreds of miles to attend foundry conventions are not of that type. For men who can read, signs are erected by other men. For men who can talk, other men can point out the way. For a man who can think, even inanimate things will come together into his intelligence so that he may travel through them and attain a great destiny in the vista of experience.

But one mortal man alone without association with other men or what they have done would lead a small enterprise in an aimless narrow path through a lifetime of honest effort and the record of all his life work would show less of value created than the work of a single bee in the organization of the hive.

We hear about the evil of the corporation. It has been clearly developed that the evil is individual and not corporate, the criminal appropriation of power not his or theirs by individual directors—a power created by and belonging to many minds, employers and employees, the greatest industrial power for good of modern times.

In this latter day business organization the individual who tries to act without reference to or regard for the aggregate acquired wisdom of his associates, superior or inferior, falls by the wayside, ceasing to be of value to the corporation.

It is as true of the individual industry as it is of the individual man that it cannot isolate itself and succeed. It may be preeminent in its special manufacture; its wares may be without a single

competitor. It may feel secure in its future because of its past and declare to itself and others that no other can supplant it in the markets of the world, while, even at the moment while its head is buried in its arrogant pride in individual independence, a new industry based on a synthetic development of public knowledge in its own specialty is exhibiting the first made machines or processes in a new line destined to supersede the old.

So far we have considered superficial, evident and more or less selfish motives for meeting our associates in convention assembled. To advertise, to show, to be shown, to benefit individually by the counsel of others to survive in competition by keeping informed by competitors—all these are selfish reasons for populating conventions. And yet through such less worthy motives most of the greater purposes of the world as of conventions are worked out.

The success of an individual manufacturer of a valuable product means much to the world, and, if only he will give as much as he receives at the convention his selfish interest in or contribution from it is made whole in the giving. Anything that helps a man or an industry to add value for his fellowmen, no matter how eagerly or selfishly sought, fulfils its higher destiny.

But there is yet a larger idea in our foundry conventions. Let us study it. Let us seek it.

In the early days of the molding machine in this country the Iron Molders' Union deliberately chose to ignore it—to keep its men away from it. They fought against it. At the time of the last convention in Philadelphia last May, the molders' union, meeting later in Philadelphia asked if the Foundry Supply Association could not hold its exhibit over till the date of their meeting so that these same molders and their officers might acquaint themselves with the very latest developments in molding machinery.

Such a request arises from no sordid selfishness.

In the very names Union, Association and Convention as in Religion no individual end is sought. All that these names stand for is the universal good.

I do not hesitate to say that I think here lies the Convention Idea and that I would be glad to see it elaborated in the Foundry Trade so that molder and foundryman might meet and study and discuss in common interest the things that are common

to both. The interests of all engaged in our foundry enterprises are absolutely identical. The molder's life, liberty and pursuit of happiness are inseparably linked with the success of his employer. The millions that have been wasted in absolutely useless strife between them would have all remained in productive industry, excepting for the wilful ignorance of each of the other's doings.

In the derivation of the name a convention signifies a coming together.

So be it. Let the Convention Idea live up to the name of the Convention. Let there come together at the convention all men and all things that can contribute to the success of the foundry industry. In the happy meeting of all that should cooperate and the bringing home to the intelligence of all who should and shall attend the convention the latest information they should share in common interest of all that has been done within the year, our Foundry Conventions must become ideal.

A well known clergyman recently wrote me "I have often wondered what would happen if labor movements became religious." He did not mean theological or churchy. My response to his higher thought has become this, as the suggestion has grown upon me. Cut out the tactics of war, and cut in the basic ideas of fair dealing; give no man a secret, unfair advantage, and let no man seek any. Substitute strength of position and strength of cause for strategy;—and you will have the survival of the fittest, the victory of the best, the guerdon of fair justice for the brave.

Let us look forward to the day when our conventions shall be lower courts of the supreme court of Public Opinion. Let the understanding between molder and foreman and foundryman be so perfect as to the latest and best methods of making castings that no subtle, selfish, or one-sided plan can ever get a *start.*

But make our Foundry Conventions means to such lofty ends, and before we know it,—the unfair outcast as unfit,—what has been the desperate struggle called a "labor movement," will have become a great integral movement of those who have vainly fought in triumphant procession with *none* led at chariot wheels—no vanquished to pass in agony under the yoke—all gained—nothing lost.

TRANSACTIONS AMERICAN FOUNDRYMEN'S ASSOCIATION

DISTRIBUTION OF TEMPERATURES IN THE CUPOLA

By J. de Clercy, Montreal, P. Q.

If it is desired to establish, by means of figures and drawings, the various temperatures produced by the reactions of the air and the gases on the fuel in the different zones of the fusion bed in a cupola, one must suppose this bed divided into a number of horizontal planes as well as vertical ones and then, take up the study of the reactions going on in each of these planes separately, supposing them to be independent of one another, then determine what influence they may have one upon the other.

Let us consider, for instance, the case of a cupola running on good average sized coke and capable of burning say, 800 lbs. of this coke to the hour. The air, supposed dry, required to effect the perfect combustion of this coke, will represent a volume of 800×150 or say: 120,000 cubic feet and will weigh about 9,600 lbs. Supposing that this air be injected into the cupola by four tuyeres, each of these tuyeres will be blowing in 2,400 pounds per hour.

Now, let us consider a certain mass of coke, located at the tuyere and adjoining it; say this coke has a horizontal area of one foot square and a vertical height of one foot also, representing about 30 lbs. of coke, or about as much of it as will burn in

an hour on a foot square of grate. The quantity of air requisite to burn this coke will be about 30×12 or: 360 pounds; while the heat developed by the reaction will be 30×13,500 or: 405,000 B. T. U.

Very nearly all of this heat is carried away by the 2,400 pounds of air sent into this zone, which we will call Zone No. 1. The specific heat of air being 0.24, the temperature of the gases upon leaving this zone will be given by the equation, $0.24 \times 2{,}400 (T-t) = 405{,}000$, in which t is the temperature of the blast air, which we will suppose to be 60 degrees Farenheit. From this equation, we get

$$T = \frac{405{,}000}{0.24 \times 2400} + 60 \text{ degrees} = 760 \text{ degrees F.}$$

This then, would be the temperature existing immediately next to the tuyere under consideration, at a depth of about half a foot from the tuyere, if we suppose as suppressed all radiation from the inner layers of coke, the conductivity of the coke itself for heat, and also the heat of the melted iron flowing down through this zone. These latter sources of heat, however, cause a notable increase in the temperature of this zone and raise it to probably 1,000 degrees or 1,100 degrees. But notwithstanding this, the actual useful effect of the combustion in the region considered is what has been calculated above. It is therefore a cold zone, in which the iron congeals and the slag running down the sides of the cupola, from the upper layers, become solidified.

Let us now take up the case of the adjoining zone, No. 2, containing an equal amount of coke. The amount of air reaching this zone will be much smaller than it is in zone No. 1, on account of the resistance of the coke itself in that zone, and also, because the air has spread out over a spherical surface. This will make the volumes of the gases traversing masses No. 1 and 2 inversely proportional to the squares of the distances of said masses from the tuyere.

Say 1,400 lbs. of gas pass through mass No. 2 in an hour's time. Then, the heat developed by the combustion of the 30 lbs. of coke will again be 405,000 B. T. U., because there will still be a great excess of air as compared to the coke to be burnt, and carbonic gas will be produced. The temperature of the gases

at leaving this zone No. 2 will then be given by the following equation:

$$0.24 \times 1400 \ (T-t) = 405{,}000$$

in which t, the temperature of the gases upon their entering this No. 2 zone, is equal to 760 degrees, the same as the temperature of these gases when leaving zone No. 1. Hence: T=1,960 degrees.

This zone will receive about as much heat from zone No. 3, as it gives up to zone No. 1.

In still another zone of 30 lbs. of coke, located further from the tuyere, there will only pass some 800 lbs. of air and burnt gases; this quantity of air not being largely in excess of the weight of fuel, and the temperature being very high at this point, carbon monoxide only, will be formed by incomplete combustion, so that the equation giving the temperature in this No. 3 zone, will be different from the others. The heat developed by 30 lbs. of coke burning to carbon monoxide will only be:

$$30 \times 4{,}000 \text{ or: } 120{,}000 \text{ B. T. U.}$$

this will make the equation as follows:

$$0.24 \times 800 \ (T-1900.) = 120{,}000$$

or: T=2585 degrees, temperature which, on account of losses by radiation and by the conductibility of the surrounding masses of fuel, must be brought down to about 2,500 degrees.

And now, in still another fourth zone, there will only be found a small quantity of entirely burnt gases so that no combustion can take place at that point and the zone itself can only be considered as gradually being absorbed by the other zones through the crushing action and consequent fall of the fuel, under the weight of the upper charges. The temperature in this zone would certainly be lower than that existing in zone No. 3, on account of the reduction phenomena taking place in it, if it were not actively and powerfully heated up by contact with zone No. 3, which it helps to cool down. This temperature must be something in the neighbourhood of 2,300 degrees in the average cupola. In the larger cupolas, however, it is considerably lower than that figure and, it is the difficulty of keeping this temperature up to a proper level, which sets the limits to the dimensions of cupolas with only one row of tuyeres.

If these zones be supposed represented by circular lines (Fig.

1) it will be seen that they intersect one another in such a manner that zones of equal temperature may be fairly represented by a number of concentric circles, having the same center as the cupola. (Fig. 2).

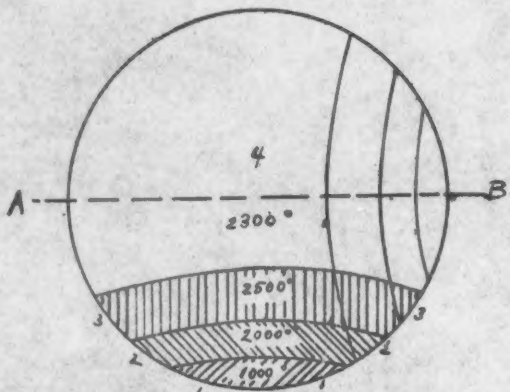
Now, if we look into the way the gases behave in one of the vertical sections of the cupola, it may be noticed that Zone No. 1 stops at a certain height above the tuyere and that this height is considerable when compared with the thickness of the zone, for the reason that the air has a tendency to move up along the walls of the cupola. Zone No. 2, in turn, rises above the first to a corresponding extent; Zone No. 3 rises still higher, and more especially follows along the side of the cupola, where it causes considerable damage by reason of its high temperature. Finally, zone No. 4, in the center, only owes its heat to gases coming through it from the other zones. It does not burn and, consequently, produces no heat of its own generation. But this zone is precisely the one which comes into contact with the solid iron and must furnish it with heat, at its own expense, either by radiation or by actual contact. This means, therefore, that another zone, No. 5 is formed in the center of the cupola, where the temperature is barely high enough to melt the iron. The fusion of the iron, in such a cupola, is therefore a slow process.

Part of the iron melted into a liquid state will go through zone No. 3 where the temperature is too high and will get oxidised while passing through it. It will make castings that are brittle and hard to work with tools. The melted slag, running down the sides of the cupola at the level of this zone, will run down to zones No. 2 and No. 1 where they will congeal, forming a sort of solid rim of slag all around the cupola and bringing it up in two or three hours at the outside.

No doubt, the conductibility of the coke and the radiation of the heat between the different zones, will tend to equalize the temperatures in the whole of the melting zone, but, notwithstanding, the differences of temperatures between zones will certainly reach several hundred degrees, just as things take place in a gas producer and the theory just given out must be taken as representing fairly well just what takes place in a foundry cupola.

What will happen now, if we put a tuyere in zone No. 2? The total volume of air remaining the same and being divided

Fig 1



Cut C-D.

Fig 2

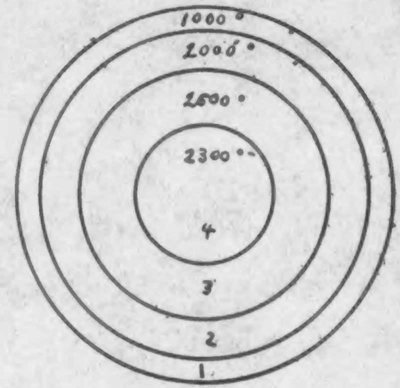
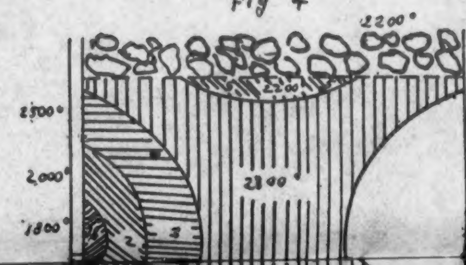
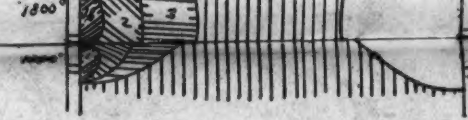


Fig 3

Fig 4

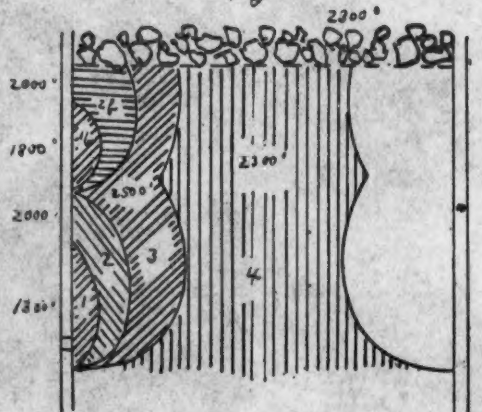


Cut A-B



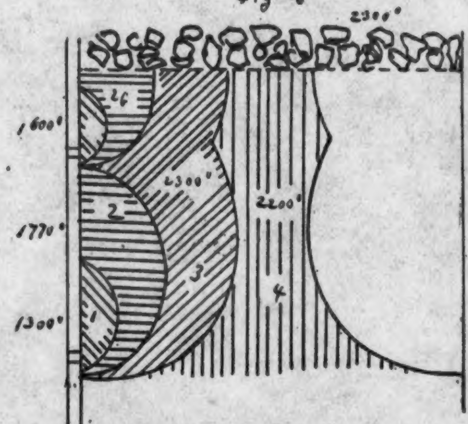
Second row of tuyeres opening into zone No 2
Dry air.

Fig 5



Second row of tuyeres opening into zone No 3:
Dry air

Fig 6



Second row of tuyeres opening into zone No 3.
Air, steam + CO_2;

between a greater number of tuyeres, a smaller quantity will pass through the lower ones. The result will at once be a higher temperature in zone No. 1. For instance, if we put 1,600 lbs. of air through this tuyere, the equation given above will become:

$$0.24 \times 1{,}600\ (T-t)=405{,}000$$

Hence: $T=1{,}115$. If one adds to this, as previously explained, say 200 degrees for the heat transmitted from Zone No. 2, we will get 1,300 degrees as the temperature of this zone No. 1 and this must be considered as an important improvement, because the scoriae will congeal and stick a great deal less around and over the tuyere.

This leaves 800 lbs. of air to be sent through the upper tuyere in order to burn the same weight of coke.

If this tuyere is situated in Zone No. 2, which has kept its temperature of about 2,000 degrees, there will be formed, over and above this tuyere, a second Zone No. 1, where the temperatures will be given by the equation:

$$0.24 \times 800\ (T-t)=260{,}000$$

in which it is supposed that the coke is burnt, one half to Carbonic Acid gas and one half to Carbon Monoxide, which is not unreasonable, and must be fairly near the truth at the temperature under consideration and with the small excess of air found there. It would then become equal to 1,400 degrees; but this temperature is largely increased by the very high temperature of the surrounding zone. Then a temperature of 1,600 degrees or 1,700 degrees can be admitted for this zone No. 1-b. At this temperature, the slags do not congeal. But above this zone, the temperatures will be higher still than they are in zone No. 3 of a cupola with a single row of tuyeres. The bricks will be eaten away quite rapidly; the scoriae will run over the orifices of the tuyeres which they will soon blind, because these orifices are necessarily small and at a low temperature, (being cooled down by the rapid current of air); so that, in the end, although there is less tendency towards the formation of a ring of congealed slags, the cupola will work irregularly and unsatisfactorily, as the upper tuyers will only run occasionally and intermittently.

If, on the contrary, the upper row of tuyeres is placed in Zone No. 3, (Fig 5), no very high temperatures will be developed next the sides of the cupola, above these tuyeres; the rim of

slags will only form very slowly in the neighbourhood of the lower tuyeres; the upper tuyeres will remain clear; the air will come and burn the gases in the very center of the iron mass, where the mixture of the gases will be effected a great deal more easily than in the bed of coke, as the interstices are much larger; a high temperature will be realised right in the middle of the mass of iron and the fusion will be a great deal more rapid. Zone 5, in fact, will have disappeared.

This should make it clear that it is important to locate the upper tuyeres at less than 8 or 10 inches from the top of the fusion Zone.

Notwithstanding these advantages, however, there still exists a zone in which temperatures up to 2,500 degrees and 2,600 degrees rule, and this affects the quality of the iron in a bad way, while the center of the cupola still has a tendency to cool down, because Zones 2 and 3 have become narrower and have come nearer to the walls of the cupola, resulting in an increased thickness of the central Zone No. 4 which, as we have seen, is of no importance in so far as the production of heat is concerned. There is then danger of too lively a combustion in the medium cylindrical vertical portion of the cupola, and, consequently, an irregular working of the cupola, the irregularity being caused by the falling down of the solid iron in the layers of coke, or reciprocally, a fact which would do away with all the advantages of the upper tuyeres and of the free movement of the flames amongst the lower layer of the mass of solid iron. The sudden drops of the mass of iron or coke which can be seen at the charging door of most cupolas, are due to these sudden collapses of the central column of coke which resists for a time, because it is not burning and then suddenly gives way laterally under the weight of the iron above which it, alone, was supporting. The disposition of the zones, in this case, is that shown in Fig. 5.

Let us suppose now, that instead of using a dry air blast, air with a certain proportion of carbonic gas and steam should be sent into the cupola. In both the cupolas considered above, the effect of this will be about nil upon zones No. 1 and No. 1-b, because the carbonic gas and the steam (when dry) behave in exactly the same manner as inert gases, in the presence of incandescent coal at temperatures under 1,200 degrees; their effect,

however, will be extremely important on zones Nos. 2 and 3, which will be very considerably thickened at the expense of zone No. 4; in this manner, almost the whole cross section of the cupola will participate in the reactions of combustion; the effect of this will be to make the gradual settling of the charges more regular, instead of leaving in the centre of the cupola, a sort of pillar of coke which can only burn by collapsing and spreading into the neighbouring zones. At the same time, the temperatures will be considerably equalized. For it is a well known fact that the cooling action of the decomposition of carbonic gas and steam are energetic and powerful in direct proportion to the temperatures of the medium they take place in and, consequently, act as powerful regulators and equalisers of heat.

Thus, Dr Bunte, in sending a flow of steam, over a bed of incandescent coke, found that at 1,245 degrees F., only 8 per cent. of this steam was decomposed; at 1,580 degrees this proportion reached the figure of 42 per cent. and at 2,060 degrees, 99 per cent. of the steam was absorbed in combination with the coke.

Let us now suppose the case of 10 lbs. of steam per hour, passing through mass No.. 1, this mass will be cooled by less than:

$$0.08 \times 10 \times 7{,}000 \text{ or } 5{,}600 \text{ B. T. U.}$$

7000 B. T. U. being taken as the approximate heat absorbed by the dissociation of 1 lb. of steam. The same weight of steam passing through mass No. 2 will cool it less than

$$7 \times 7{,}000 \text{ or } 49{,}000 \text{ B. T. U.}$$

and finally, the same weight of steam again, passing through the dangerous zone No. 3 will cool it by

$$10 \times 7{,}000 \text{ or } 70{,}000 \text{ B. T. U.}$$

and if we subtract for each zone, the quantity of steam withheld by the other zones preceding it, we will find that zone No. 1 having remained practically unchanged in form by this addition of steam keeps about the same temperature; zone No. 2 receives 10×0.80 or about 9.2 lbs. of steam, of which 70 per cent. is decomposed and absorbs for its decomposition:

$$9.2 \times 0.7 \times 7{,}000 \text{ or: } 45{,}080 \text{ B. T. U.}$$

This zone will be found to have widened and the temperature

of the gases issuing from it, will be given with sufficient approximation by the following equation:

$$0.24 \times 1,400\ (T-t)=405,000-45,080$$

whence: $T=1770°$ degrees. Finally, in zone No. 3, there will be 2.76 lbs. of steam which, by their dissociation, will absorb: 19,-320 B. T. U., allowing the following equation:

$$0.24 \times 800\ (T-t)=120,000-19,320$$

whence: $T=2293$ degrees; a temperature which is inferior by 300 degrees to that of the same zone, when running on dry blast.

The difference between zones 2 and 3 is further diminished, to the extent of becoming almost nil, on account of the interchange of heat between zones, so that the whole mass is equally and evenly heated throughout, except near the walls, where the temperatures will necessarily be lower. Along their vertical sections, the zones take on considerable height.

Now, if we add a second row of tuyeres, it will be seen, according to the preceding study of the ordinary cupola with two rows of tuyeres and run with a dry blast, that the temperature will remain uniformly at about 1,600 degrees along the wall of the cupola, and over the whole height of the fusion zone. In this manner, the destruction of the wall by slag will be reduced to a minimum, instead of the wall being subjected to irregular and excessive temperatures, as in the case of the dry blast cupola; no deposit of solidified scoriae will take place either, around the tuyeres. The most active combustion will be found to be going on right in the center of the mass of iron; it will therefore be quite rapid; it will also be regular, because the charges will be coming down regularly and evenly over the whole horizontal section of the cupola, instead of coming down, faster than elsewhere, in the medium vertical cylindrical section of the cupola, as it does in the case of the dry blast cupola, where a central vertical zone is left without any combustion going on within its limits. The latter zone is very much reduced in this case.

To the above it can only be added that when running with large sized anthracite coal, the zones will be very markedly increased in thickness and heightened along the walls, even to the extent of making a second row of tuyeres more of an objection than a useful addition to the installation.

Finally the addition of carbonic acid gas to the blast will produce an effect similar to that of steam. Figs. 5 and 6.

PROCEEDINGS OF THE TORONTO CONVENTION.

Opening Session, June 9, 1908, 3 P. M., Held in the Dairy Building, Exposition Park.

President Stanley G. Flagg, Jr., in the chair. President Flagg introduced to the assemblage, His Worship, Mayor Oliver, who thereupon made the following address.

Mayor Oliver:—Mr. President, Ladies and Gentlemen:—We have made an arrangement, or I did, with your President when I came in here that on account of the warm weather, I should say,—"How do you do? Glad to see you; Good afternoon; Hope you have a good time; and he was to say how pleased you all were to be here, etc. However, on behalf of the City of Toronto, I would heartily welcome you, and sincerely hope you will have a pleasant time with us. We are desirous of having all the conventions possible to meet in our City, because we feel if we can only get you to come two or three times, you will be so impressed with the beauty of our City and the business advantages which it offers, that if you do not come here permanently, you will at least start a branch factory in our midst.

We welcome all the industries we can possibly get. We welcome you here because we know you are doing a work which is a great benefit to the various trades and industries with which you are connected. I understand from your President that any

new inventions you succeed in producing during the year are shown here and are explained, and everything brought out in discussion is gone into very fully. I know a little about manufacturing, but not very much. I once or twice was induced to become interested in a patent that was going, in all cases, to revolutionize everything, and we would be able to do things for about half what we were paying at the present time, but it usually ended in investing the money, which is still invested. I have no doubt some members of your Association have had similar experiences. The last one, the gentleman wanted me to go into, was that of a round augur that would bore a square hole in a steel casting. I decided to pass it by.

However, I do not wish to take up your time more than to say we welcome you to our City, I also wish to say that about the 29th of August to the 14th of September next we hold on these grounds our Great Annual Exhibition. We would be glad to have you exhibit your different machines and exemplify the various processes of manufacture during those two weeks. We have an attendance as high as 120,000 people in one day, and we think if you came over here and should exhibit at the Canadian National Exhibition, you would find it not only one of interest to you but one which would pay you from a financial standpoint.

I also desire to extend to you the hospitality of the City of Toronto, and would ask all of you to come down tonight and attend the reception which will be held in the City Hall from 8.30 to 10 or later, if necessary, when we will endeavor to give you some good music and should you desire to have a dance, I do not know but what we will be able to accommodate you.

As said before, the weather is very warm, and I only wish to repeat the statement that I am very glad to welcome you to our City. I hope the time is not far off when we Canadians will annex the United States and all shall become one people. If we cannot annex you en bloc, we will have to be contented with annexing you piecemeal. We want to have some of you anyway, and are always glad to welcome that portion of you who find your way to our shores.

President Flagg, after a few well chosen remarks in response to His Worship's welcome, thereupon called on Mr. E. H. Mum-

ford, President of the Foundry Supply Association, Mr. Chas. J. Caley, President of the American Brass Founder's Association, and Mr. W. S. McQuillan, Vice President of the Associated Foundry Foreman; who on behalf of their several Associations responded briefly, expressing their pleasure in being in Toronto, and stated their appreciation of the kind welcome extended by His Worship the Mayor.

After this, the Band of the 48th Regiment, Highlanders, who were in attendance, enlivened the occasion with a very fine selection of National airs, both British and American. They aroused a very high pitch of enthusiasm, after which the great assemblage quieted down and listened to the serious and instructive remarks of the President in his Annual Address.

ADDRESS OF PRESIDENT STANLEY G. FLAGG, Jr.

I want to say a few words to you today, not so much along technical lines, but, it seems to me, on the subject which ought to lie closely to our hearts; namely the development of our Association.

I feel, as within my recollection, that the Philadelphia meeting last year marked an epoch in the history of our Association, perhaps as much as anything, on account of the introduction of the practical side of the shop. Our cooperation with the newly formed Foundry Supply Association was productive of the most happy results, and from evidences before our eyes, the work of this affiliated association bids fair to do yet even more in the future to make our Conventions stand out as memorable affairs in our years' experiences.

Originally it cost a little more money to become a member of this Association, and it has been the effort of our Secretary and myself during the past year to see if we could not do something to make this membership more valuable. I am sure our meetings have developed that point, and, we hope by the work of our Secretary, ably seconded as it has been in the past, by many of our members, we shall make it still more valuable.

This, it might be well to remember, is our annual meeting, and it will be remarkable as being the first one ever held outside of our own domestic limits. "American" in the larger sense. This is a year of curtailment of business and its accompanying

severe test of the financial strength of our manufacturing industries, and yet in spite of all this, you will note particularly, I think, how free we are from any evidences of discouragement and pessimism.

The social side of our Conventions is, I think, quite an important one. The making of new acquaintances and the renewing of those we have made at our preceding meetings is most happy. Acquaintance and association amongst competitors seems to be the line along which most of our industries and, perhaps, those which are now our own, are developing. We do not consider a man nowadays, because he is in the same line we are, as an enemy, but rather as a co-worker. Such institutions as this have done more than their share to strengthen that sentiment, and I trust that all of us have many friends in this American Foundrymen's Association.

One of the subjects to come before this Convention is the careful consideration of an increase in dues. I throw out this hint simply to give you an opportunity to think it over. Whether it would be wise to do so or not of course will be decided by the sense of the meeting when it has been placed before you and discussed. Membership in the American Foundrymen's Association is really worth while. It is a substantial business asset. Mark you, there has hardly been an investigation of note carried on in foundry work, in metallurgy, or its allied lines that has not either had its development or successful issue described and worked out in our literature. This literature is now widely distributed in the trade publications not only of our own country, but of Europe and almost every country that is interested in the foundry industry.

You feel, I know, that foundry practice owes an incalculable debt to this Association; that we have assisted in its development, and are now at a point where we should exert ourselves along perhaps different lines. Not necessarily perhaps newer lines, but lines more fully developed. If you look over our literature, you will find we have page after page of ultimate, careful analyses, but we have not yet learned, I believe, just what all those analyses really mean. There is too much unexplained, too much not understood. Professor Howe said, I think ten years

ago, that in the steel business in time to come the man who talked of ultimate chemical analyses would be as far behind the times as the man who talks of the analyses of a piece of rock.

The whole field has been pretty thoroughly covered, and if we are to lead in future as in the past we must look ahead for this and other new grounds, and investigate more thoroughly and on more scientific lines. To do this will cost more money, more time, more energy, and I believe we will find will be worth more.

If this subject to which I am referring perhaps more than you think necessary, this subject of increased dues, should mean a small decrease in membership, I believe we might expect a more enthusiastic body of workers, more aggressive and more enterprising.

Our meetings, you will all agree with me, are most enjoyable, but their profitableness lies perhaps in the greatest measure in the new ideas we get, the thoughts they stimulate, and the plans we carry home with us to work out in our own way.

The Foremen's Association has done much work and will I believe continue to do still greater good. They are adding to our literature. I regret, however, to say that our metallurgical section, consisting as it does of the most highly trained specialists in our Association, have not been very active. Of course, I know the more scientific Associations appeal perhaps more strongly to this class of workers and thinkers than does our own, but I wish to call attention to the opportunities given here of combining the scientific work with the practical application.

It is a matter of great regret to our Secretary that, by reason of lack of funds, he has not been able to continue, for some time, the issue of the "Review", but I hope, and I may say I believe with the prospects of an increased income which we have he may be able to place this publication before us on its usual high level. Although a busy man, our Secretary has done a great deal of editorial work and will, I trust, tell you something of it at the present meeting. We should have more of this work and more money is required to meet the cost.

You will probably find, if you look over a copy of the proceedings of our previous meetings that it was customary for the President to read a paper, and if I were going to follow that

precedent, I think I should talk to you upon enlarging the application of the technical side of our business. The machines in the foundry have been greatly improved from the time when the hand squeezer was considered a formidable piece of mechanism, and was looked upon with suspicion if not with distrust. From this simple appliance, we have come up to the highly developed and specialized molding machines of the present day. Outside the molding shop, we have appliances for mixing and treating sand, the recovery of shot and waste sand, until we find even the most modest jobbing foundry erected within recent years equipped with its quota of machinery and appliances, thereby reducing the labor cost and increasing the product as well. What better proof can be found of this than this very fine and comprehensive exhibit of foundry appliances brought here for our information and for our study?

Of course, specializing in production has been a great factor in furnishing just the opportunity for this development. Without it, perhaps progress would have been slower, but who shall decide whether specializing was the effect or the cause? but the development of the future depends very largely on the practical use and application of the technical data of which we have such vast quantities stored up in the scientific publications of today, in the Transactions of our own American Foundrymen's Association. My experience is that most of us neglect to read them at all, and many do so carelessly. Hardly a subject is left untouched and the ideas and suggestions are presented clearly and generally very fully. Read the reports of Keep, West, and our own Moldenke. I suggest that those who have copies of the Reviews and Papers get them bound so that they may be accessible not only to yourselves, but to your chemists, and even foremen and mechanics. We must not be content with what we have done.

You will perhaps hear more in detail from the Secretary of the work done by him, and while we all know his enthusiasm as well as his modesty, I trust you will believe me when I say that he has not fallen one whit behind the high standard which he set for himself in the past.

I wish to thank you all for your presence here and hope that

this meeting may stand out as the most satisfactory and enjoyable Convention we have yet attended.

The President's Address was listened to with much attention, and the recommendations kept for a general discussion at the last business session of the Association.

The Secretary-Treasurer, Dr. R. Moldenke, then read his annual report as follows:

REPORT OF SECRETARY-TREASURER

Your Secretary begs to report a year of exceptional activity in Association work. Perhaps no one thing has stimulated the educational movement in the Foundry Industry as much as the magnificent exhibition of Foundry Machinery and Appliances at the Philadelphia Convention held last year. Foundrymen are waking up to the fact that they must re-equip their plants to meet modern conditions, and the creation of these modern conditions are directly traceable to the work of our Association. But for the dissemination of information on such subjects as the molding machine, the technical and scientific management of mixtures and melting, and other items of progress, the industry would not be where it is today.

We should therefore encourage the efforts of our allied Supply Association, and urge the individual manufacturers to continue to improve their product, so that the foundry industry of America may hold its place as the first in the world.

That foundry progress is firmly established now, can be seen from the flood of inquiry received by the Secretary's office asking information on every conceivable phase of the art of founding metals. In a number of instances, foundry owners have brought their troublesome castings with them to New York to go over the situation with us, and it is hoped derived benefit therefrom.

Our President will tell you of the effort made in raising a special fund for more effective studies to be made along the lines of important foundry problems, and your Secretary is pleased to report that already two items of research work have been carried along sufficiently to report, and a third is well under way. These

are the studies with Vanadium in cast iron recently published in the Transactions, and the use of titanium, similarly, presented at this Convention.

The study of molding sands is now far enough under way, so far as the gathering and preparation of the fifty odd samples is concerned, to indicate some very interesting results ahead. These sands were kindly donated to the Association in sufficient quantity to make the experiments worth while. Further lines of investigation are contemplated, so that by the time of the next convention, we should have a substantial addition to our fund of knowledge.

The relations of the Association with kindred organizations has continued to be most cordial, and much correspondence has passed between Europe and this country.

Toward the end of the year, the burden of work became too great for the Secretary alone, and hence assistance was engaged to cope with the ordinary routine. Over 200 pages of printed matter were issued to the members, and it is expected that next year more attention can be given the Foundry Reviews. Owing to the objection on the part of many members to the size of the publications, return is made to the old style, and our thanks are cordially tendered THE FOUNDRY for past favors which have saved us much money.

At the present time there are 715 members, which shows a gratifying increase over last year, and incidentally the regard in which the Association is held.

The financial statement is as follows:

Balance from last year $635.94, which included many dues paid in advance and in reality for this year. Received during the year for dues the sum of $2,180. Total income $2,816.

Expenses: For the Transactions $461.88. For Printing $119.85. For Postage $403. For Salaries $1,357.05. For Sundries $14.18. For Expense of Committees and Convention Preparations $135.01. Total $2,490.97, leaving a balance of $325.22 in the Treasury.

The Special Fund collected amounted to $885. Expended for freight, labor, etc., $36.83, leaving a balance of $848.17.

There remains but to thank the membership for the continued courtesy which has marked the relation of the Association to

the office of its Secretary, and to hope that the increasing prestige of our body will mean the bringing out of still greater results for the general good.

Respectfully submitted,

RICHARD MOLDENKE,

Secretary-Treasurer.

The Report of the Auditing Committee then being called for, it was presented as follows:

To the Members of the American Foundrymen's Association:

Having been appointed as a committee to audit the accounts of the Secretary-Treasurer of your Association, we the undersigned, beg to report that we have examined them, and found them to be correct.

J. S. SEAMAN,

WM. YAGLE,

Committee.

The President then declared the meeting adjourned until 10 o'clock the following day.

THE RECEPTION BY THE MUNICIPALITY

Probably the most notable of the Social events occurring during the thirteen Conventions of our Association, was the magnificent Reception tendered the Members and Guests of the allied Associations by the Governing Body of the City of Toronto. His Worship Mayor and Mrs. Oliver received, aided by the members of the Civic Government, the Aldermen, Commissioners, and Dignitaries of the Province.

In the magnificent City Hall, tastefully decorated, and with Reception Rooms and Council Chambers converted into bowers of roses, to the strains of Canada's two finest Bands, a steady stream of delighted guests filed past the high dais on which stood the Hosts of the evening. The traditional Officers of the Guard stood attention in strictest military style in the corridors, halls and at the entrance; and the Reception Committee headed by the lovable Vice President of our Association for Canada, Mr. L. L. Anthes, made every one feel most comfortable and happy.

A building of grand proportions, erected without the slightest

aspersion of graft, decorated in a spirit of munificence, and thrown open for the occasion with the greatest of hospitality; it made the visitors from the United States ponder, and wonder also at the hardiness of the race so far North. Especially one painting—that of Majuba Hill—attracted the attention of the thoughtful, who were thus brought face to face with a period when Canadian blood helped to dispel the awful gloom of the British Empire in those trying days.

The extraordinary vigor of the people, the cheerful spirit and helpfulness displayed everywhere, more particularly the pride taken in the city itself and its cleanliness and enterprise, all combined to make the Convention Delegates and their Ladies feel at home as they never have before. The evening which ended with a dainty collation served by fair Canadians, and the dancing of the younger spirits in the spacious halls, will be ever recalled by those who were present as one of the very nice things that our Hosts did for us. To us as American citizens further this spontaneous greeting of our Canadian members and friends made it an event of International courtesy, which will be long and gratefully remembered.

SECOND SESSION

Wednesday Morning, June 10th. The President called the meeting to order at 10.45 A. M., and acknowledged on behalf of the Association the exceeding courtesy with which the membership had been received on the previous evening. The first paper, by Mr. Porter was then taken up. It forms pages 1 to 6 of the Transactions.

DISCUSSION ON "SHOP MANAGEMENT"

Note by the Secretary: The many calls for additional information on Mr. Porter's method of applying the Golden Rule in the Shop has led to the request on the part of the Secretary for a written discussion on the practical working of the method by the Author. Mr. Porter has kindly consented, and his comments are given herewith.

Mr. H. F. J. Porter: I feel that the democratic method of shop management will largely prevent disputes between the

management and the operatives. Let me give a few instances to show on what foundation this assertion is based.

In a foundry which I was asked to reorganize, the manager on the day of my arrival took from his desk a paper and handed it to me with the remark, "Here is one of the first things for you to take up. I have had it for some time and have held it pending the employment of a new manager." I looked it over. It was a demand by the men for a half holiday for the summer, a 55 hour working week for 60 hours' pay." I said to the manager, "What would you have done with this paper if the men had insisted upon your action upon it?" He said, "They have already been in to see me twice about it. I would have put them off as long as possible and then refused the demand. We are not making money as it is, and we can't afford to lessen the amount of work performed and yet pay the same money we are now paying."

That afternoon I arranged for closing the foundry a half hour earlier than usual and arranged for a meeting of the men at which it was stated something would be said to them. At this meeting, after being introduced as the new manager, I told them of the change in form of shop management I intended to make and explained that hereafter they would have a voice in running the place. I asked them to elect representatives to the "works committee" and outlined the "suggestion system." I told them that one of the first things I was going to ask the committee to consider was the paper asking for a Saturday half holiday. I pointed out to them the fact that the paper had not been signed by all the men in the place and asked why the others had not signed it. The management did not know whether it represented the wishes of all the men or not. I said "you know that it is very easy for a man to take a paper around a shop like this and ask for signatures to a request for a half holiday at full pay. "But" I said, "you know that you can't do much in a foundry in a half day, and as we are not making money now we can't afford to pay for time without work. The management wants to treat you fairly but it wants you to treat the company fairly and I did not think that the demand as made was a fair one." One of the workman spoke up and said "We work from 7 o'clock Monday morning till 6 o'clock Saturday night. Many of us have to get

up at 5 o'clock in the morning to get here on time and we don't get home till 7. We never get a chance to go any where for enjoyment and we can't do any shopping for ourselves or with our families unless we take time off. That is our side of the story." I said "We are 'getting together' fast. Already we are learning each others side. I hope that men like you will be elected on the committee. We want to deal with intelligent men who are frank and honest. Now I am sure you will send the paper back to us with the question more carefully considered than it has been."

The men promptly organized and elected their "works committee" and the following week they met and acted on the matter. In a few days we received a very courteous request for a full holiday every other Saturday, so that a full day could be put in in the foundry. This was to be for a month on trial, with the statement that if they did not do as much work as before they should go back to the old time. They wanted the equivalent of a 56 hour working week for 58 hours' pay. This the management accepted. The first month was a success and the new arrangement was continued for three months of the summer. In the fall without any solicitation on the part of the management the men asked for a continuance of the arrangement all the year round but said they wanted to have a 55 hour working week and 55 hours' pay as they did not any longer want to receive something for nothing.

Now another instance, the men had been accustomed to quit work in the afternoon when the whistle blew unless the pour was not finished in which case they staid and were paid overtime. They soon requested to be allowed to quit when the cupola bottom dropped. If this should happen early before the whistle blew they were to be allowed to leave without being docked. If for some reason it should be delayed until after the whistle blew they offered to stay and work overtime for nothing. Of course this proposition based on a give and take principle was accepted by the management, at once. Now it happened that for several months the pour was finished before the whistle blew and the men enjoyed the privilege of going home from a few moments to half an hour early every evening. It happened

eventually however that in one week on account of some repairs which were being made to the engine running the fan, there was a delay in the melt and the men had to stay after the whistle blew on two evenings in succession. The personel of the foundry organization had changed considerably since the agreement above referred to had been made and several new men had come in. When these latter did not receive overtime pay in their envelopes for the time they worked after the whistle blew on the occasions mentioned, they at once came to the office and asked for the amount which they claimed was due them. They were told of the agreement which had been entered into between the men and the management and it was pointed out that the proposal on which it had been made had come from the men. It was also impressed upon them that they had been enjoying the early release from work every afternoon for many weeks. They were however obdurate, saying that they had come to the place after the agreement had been made and were not therefore a party to it, and that they would not work overtime without pay. Eventually the sober sense of the works committee prevailed, and all but one of the men quietly agreed, and this man was one who had come to work on just the two days in question.

I could go on indefinitely giving instances of how trouble was avoided by this method of "getting together" the management and the men, but the above should be sufficient to exemplify the working of its principles.

The Secretary then read the paper on the Production of Automobile Cylinders, by Mr. L. N. Perrault. (pages 49 to 55 of the Transactions)

DISCUSSION ON THE PRODUCTION OF AUTOMOBILE CYLINDERS

MR. J. J. WILSON; I have from time to time introduced in different places cylinders that have been pickled. While this has its advantages, it also has its disadvantages. It is almost impossible to tell whether or not the sand is entirely rapped out of the water chamber without breaking or cutting the cylinder up, as there are remote parts into which it is difficult to get a wire, and the pickle is liable to harden the sand and has a tendency to

cake it so that further treatment, if they should be tumbled afterwards, will not remove the sand completely. But in tumbling the cylinder, instead of putting it into pickle, this has a tendency to rap out more sand, and when the tumbler is packed by an expert, the cylinders will clean up and polish and still have material there to protect the thin outer wall. I believe we get a much cleaner interior this way than we would by pickling. The process of testing the cylinder to find out whether sound or not with water pressure (to whatever pressure tested, say 50 to 100 lbs.) by being boiled in hot water afterwards, heats the cylinder up so that the remaining sand dries and is readily knocked out in the process of tumbling.

I would like to say a word on the variation of analyses in France and the United States. I have had a number of French cylinders analysed. I have also had cylinders made in France and the analyses have run,—Silicon from 1.64 to about 2.30. Phosphorus from about 1.20 to 1.70, and the cylinder which had 1.70 phosphorus I must confess was very weak and brittle and, I should think, would not withstand very much of a shock. In the United States we seem to go the other way. The average analysis I think in the United States on this make of gasoline cylinders will run possibly from .30 to .60 phosphorus and perhaps from .50 to .90 manganese. I would like to hear from someone in regard to why there should be such a variation in the analyses, why the French should use the higher phosphorus iron and we the higher manganese. Whether it is because that is the only kind of iron they have or whether they have found it an advantage. If any one has data on the wearing qualities of the two cylinders I would be pleased to hear it.

The analysis of an automobile cylinder has quite a wide range. Fourteen or fifteen months ago, there were published in the Automobile Trade Journal, the analyses of thirteen different cylinders. These cylinders were taken from different automobile manufacturers. The silicon, as I remember would run from 3% to 1½%; I do not know but lower; the phosphorus and manganese had a wider range.

MR. LESH; I would like to ask what quantity of sulphur is found in the French and American cylinders. Perhaps that may account for the difference in the phosphorus and manganese.

MR. WILSON; As I remember, the analysis of the French cylinder, the sulphur ran fully as high as the American. It will run in the neighborhood of .09, .10 and .11, and American cylinders will run higher and lower.

THE PRESIDENT; Would there be any difference in the shock resisting gravity? I do not believe they mix their irons over there very scientifically.

MR. WILSON; I believe in France the native irons are all more or less high in phosphorus. As to the sulphur, this is also high and cannot be corrected as I do not understand that it could be done in crucibles. From the first I believed that the reason we were using manganese was to eliminate more or less of the sulphur and bring it down to possibly the same as that in the French cylinders.

THE PRESIDENT; Do you put the Manganese in the ladle or melt it in the cupola with the pig iron?

MR. WILSON; Both. Personally I cannot see there was any difference in the results. I have used it both ways in the ladle, cupola and the pig iron. I would prefer to use it in the pig iron. My next choice would be the cupola and then the ladle.

MR. JENKINS; You were speaking of the analyses that were published in that trade journal something over a year ago. I happen to have them with me. If it would be interesting I can give those variations. In fact, I know which was the French cylinder in the list of the thirteen cylinders, which was compiled by Mr. Job, of Booth Garret & Blair.

NO.	TOTAL CARBON.	COMBINED CARBON.	GRAPHITIC CARBON.	MANGANESE.	SULPHUR.	SILICON.	PHOSPHORUS.	TENSILE STRENGTH.
1.	3.35	.514	2.84	.431	0.94	2.31	.505	22,600
2.	3.02	.438	2.58	.228	.053	2.70	.463	18,970
3.	3.47	.408	3.06	.406	.102	2.45	.717	17,940
4.	3.35	.106	3.24	.469	.083	2.59	.566	15,880
5.	3.04	.088	2.95	.322	.104	2.55	.820	19,750
6.	3.19	.142	3.05	.273	.047	2.98	.889	17,270
7.	3.24	.098	3.14	.385	.111	2.67	.733	23,930
8.	3.35	.594	2.75	.525	.084	2.30	.807	22,900
9.	3.75	.656	3.09	.417	.083	1.60	.536	18,460
10.	2.87	.028	2.84	.445	.159	3.26	.926	25,030
11.	2.52	.624	2.90	.476	.091	1.72	.578	25,260
12.	3.91	.620	3.29	.823	.068	1.67	.444	21,330
13.	3.61	.758	2.85	.518	.093	1.38	.620	14,710

No. 3 is the French cylinder.

I have, from another source, some more of the French analyses. I will give you a couple of them which shows there is some difference.

SILICON	SULPHUR	PHOSPHOROUS	MANGANESE	GRAPHITIC CARBON
1.47	.075	.127	.60	2.63
1.5	1.03	.862	.43	2.82

THE PRESIDENT; It is possible to get a cylinder too soft?

MR. JENKINS; I consider it so, personally.

The President then called upon Mr. F. W. Stickle to read his paper on Automobile Cylinder making. Mr. Stickle regretted that he had not had sufficient time to work out a paper, but in view of the very full discussion of the subject by Mr. Perrault, would simply add a few metallurgical memoranda.

MR. F. W. STICKLE ON AUTOMOBILE CYLINDERS

I have had two analyses made from cylinders for automobiles in my foundry. The cylinders were cast six months apart.

NO.	GRAPHITIC CARBON	COMB. CARBON	MANGANESE	SULPHUR	SILICON	PHOSPHORUS
1.	2.72	.45	.39	.13	1.99	.65
2.	2.57	.77	.39	.09	1.89	.70

In my experience I find that what is wanted specially is an iron which will withstand severe shock. I never use the tensile test for my bars, but only the Transaverse.

The best French cylinder I have been ever able to get hold of —a Mercedes—has about the same analyses as mine, except that the phosphorus is higher. Here it is;

Graphitic Carbon	3.26
Combined Carbon	.90
Phosphorus	.83
Manganese	.60
Sulphur	.09
Silicon	2.29

A great deal has been said about the superior quality of French automobile cylinders. The high phosphorus contained in them has always seemed to me to be a serious detriment. I believe their object in using a high sulphur iron is to get it sound in the casting.

Mr. Stickle here referred to the severe tests the American castings are put to before they can go into service, and stated that the slightest defect even to a speck as small as the point of a pin was sufficient to send the casting to the scrap heap. He further stated that he doubted very much if the foreign made cylinders, about the superiority of which we heard so much, would pass our American inspectors.

Mr. Stickle then passed around a turned and polished test casting which he did not bring for the purpose but as he had it here it would serve to illustrate. He also showed a piece of the test bar of the first analysis as well as one of Mr. Keep's test bars.

MR. WEST; Your total carbon is 3.34. Is that not rather high?

MR. STICKLE; Yes it is, about 3.15 would be a better carbon content for such light castings.

MR. WEST; What is the best way to get the cores out of cylinders?

MR. STICKLE; We by all means get the cores out before they enter the pickle. We pickle all our castings. It is our intention to get the cores out entirely before pickling.

MR. OLDS; In connection with the analyses Mr. Stickle gave of those cylinders, I would like to ask if he used any steel scrap in his mixtures, because in my daily practice we are called upon frequently to make tests for Government work, and, using the same analysis I have never been able to get much over 2,800 lbs., occasionally 3,000, but never to 3,800 lbs. for my bars.

MR. STICKLE; If you have brought down your total carbon and silicon, I cannot see why you cannot accomplish it, unless there is a physical defect in the iron.

DISCUSSION ON MACHINE MOLDING.

NOTE BY THE SECRETARY—The subject of Machine Molding was kindly taken in hand by Mr. E. H. Mumford of Philadelphia, who drew up the set of questions subjoined, opened up the dis-

cussion, and carried it through the morning and afternoon sessions. Mr. Mumford also went over the minutes of the meeting, and prepared the closure to the discussion.

A SERIES OF QUESTIONS TO FORM THE BASIS FOR A DISCUSSION ON THE ABOVE SUBJECT AT THE TORONTO CONVENTION.

1. Is there anything by which to appraise a Molding Machine other than the ratio of value of castings produced to cost of production?

2. When do portable Molding Machines pay better than stationary Machines? Why?

3. When do stationary Molding Machines pay better than portable Machines? Why?

4. What part of the work of Machine Molding is getting sand to Machines and getting the molds off the Machines to the floor (a) in Hand Rammed or Portable Machines? and (b) in Power Rammed or Stationary Machines?

5. What increase of output is afforded stationary machines by power sand supply over that when sand is shovelled from the heap?

6. What increase of output is afforded stationary machines by immediate disposal of mold parts, so that the operator does not have to set and close his own work on the floor?

7. What does power sand supply cost per machine?

8. What does off-bearing of molds by off-bearers or power mold tables cost?

9. What is the limit of depth and the size of flask at which power-ramming by pressure ceases to pay?

10. What is the limit of depth and weight of mold at which Jolt Ramming ceases to pay?

Mr. Mumford, in opening the discussion on Machine Molding, read a letter from a prominent and wellknown manufacturer,

relating to the Ethics of the Molding Machine. The letter is given herewith:

MY DEAR MR. MUMFORD:

I give you below a few thoughts and some advice on Molding Machines.

In the first place, I am not speaking of Molding Machines as an inexperienced man, as I have used Molding Machines in their different forms since the inception of the first "squeezer."

Molding Machines have been on the market for a great many years and there have been a great many experiments and improvements made upon them, so that today their position is certainly better, so far as construction and capacity to do the work is concerned, than it has been at any previous time, and yet the progress made by the Molding Machine has been most wonderfully slow, and I think much of the slowness of introduction, as well as poor results and disappointments on the part of the user, has arisen from their name, i. e., "Molding Machine." Had these so-called "Molding Machines" been introduced to the manufacturer as "aids to molding" and not as "machines" which any laborer could take and produce as good or better molds than the experienced molder, your position would be far different from what it is today, inasmuch as there would be a very greatly increased number of machines in use now, and the sooner this idea that any laborer can work a molding machine and produce castings better than the molder, is eliminated, the more molding machines will be sold.

I believe it is a fact that it is a most exceedingly rare case where a molding machine has been introduced into a shop of molders, with a laborer as the operator, that it has not been a disappointment both to the maker and the purchaser. A molder is made by experience; a good machine operator is also made by experience, and when the machine operator has the required amount of experience he becomes a molder.

The only places where molding machines run by laborers have been used successfully, have been shops where they have been introduced and laborers employed and the molder absolutely eliminated from the shop. In the course of time the laborers become experienced and may properly be called molders. That

this is recognized by the Iron Molders' Union is apparent from the fact that they organize machine operators or molders and take them into the Union, but, should you desire to increase your machine capacity, introduce a new machine and a new laborer, this laborer's production, for either quality or quantity would be very much below that of the experienced man. Such being the case would it not very much facilitate the introduction of so-called "machines" to frankly acknowledge the situation, make a deal with the molder and put the present molder on the machine under conditions which are absolutely fair and equitable, allowing the manufacturer all of the value which comes from the use of machinery. Tests could be made on the quantity of work produced under the new method, and these would determine absolutely the price to be paid, making the basis the old molding price or time consumed in making a given quantity of molds.

To illustrate: If a certain pattern now pays 7c. on the bench and this pattern is placed on the machine, either as a single pattern or as multiples of the same, let the molder choose an expert working as hard as he is able to mold and pour off and shake out 30 molds in three hours, at 7c. each, equalling $2.10. Then let the manufacturer choose an expert who shall produce 60 molds or 60 castings on the machine, pour off and shake out the same in three hours he also working as hard as he can; the price on the machine becomes automatically 3½c. The manufacturer receives all the profit due to the introduction of the machine; the molder performs the same amount of labor on the machine as he did on the bench and receives the same amount of pay, neither more nor less than his earning capacity on the bench. This would, of course, apply to day work in like ratio.

There is no doubt that the molder is ready today to make a fair, square deal on this equitable basis, and there is also no doubt but what he will *as an individual* oppose the introduction of anything which will decrease his wages and lessen his earning capacity, or take away the material comforts to which he is now accustomed. This element enters into the problem, and enters into it with all the force that there is in human nature. In acting thus, he is simply acting up to the tenets of human

nature, and acting exactly as the manufacturer would act were their positions reversed.

I have no fault to find with the molders resisting the attempt to deprive him of the material comforts which he has enjoyed for so many years, and, to reiterate, the molding machine will never have a universal success until the manufacturers of molding machines unite in frowning down the idea of the handyman and advocating the use of the machine by the molder under some equitable system such as is outlined above.

The fairy tales told by the different representatives of molding machines, and the illustrations made in a ten-minute to-one-hour test case, cause many manufacturers to believe that all they have to do is to buy a molding machine, locate it in their shop, melt their iron and collect their castings, and this works very much to the detriment of the molding machine business.

There is no molding machine yet made which by any manner of means eliminates the molder. One machine rams the mold, another machine will draw the pattern, and there are many and varied methods of accomplishing these results, but there is only one machine to my knowledge that practically relegates the molding proposition to the shovelling of sand and the carrying away of molds, and this machine has a very limited capacity for variety of work.

You also have to solve the question of transportation in a way that it has not yet been solved, to make your molding machine a permanent and desirable factor.

The average manufacturer is entranced with the idea of the molding machine, and he buys one, two or three, but he finds himself under the best conditions, face to face with this question of transportation, i. e., the transportation of the mold to its position on the floor, and the getting of it back again to the main sand heap. This consumes an enormous amount of time, which many have attempted to solve by continuous melt, but as yet the continuous melting plan seems to have made very little progress."

Mr. Mumford: The question before us is evidently, Is there not a good commercial basis, upon which the molding machine may be operated to a better advantage by the molder than by the

untrained laborer? The question of the Ethics of the Molding Machine is a very important one. When a machine is to be installed in a shop, a manufacturer often hesitates before putting one in on account of the position that may be taken by the men whose work it supplements. I claim that if the subject is handled carefully but frankly, in the end the molding machine is a peacemaker. There is nothing more expensive than war and strikes, and both manufacturers and molders on especially the question of piece work labor are finding the same means effective in settling this vexed question. Given a thoroughly equitable basis by which the molder would give the foundryman a square deal, while the foundryman sees that the molder suffers no reduction in his income, a point may be arrived at at which the molder would share slightly the benefit derived from the use of the machine.

MR. WILSON: Is it not a fact that only within the last year or two has the molder been willing to operate a machine. Moreover, is it not thus because he sees that unless he does so the machine will continue to gain ground even faster than it is today? What would be the result in a year or two if we did away with the handy-man, and put molders to run machines?

MR. MUMFORD: I agree with Mr. Wilson, in that to put a molder on a machine has always heretofore meant a holding back of the product. I do say, however, that, while the history of the molder and the machine has been one of absolute neglect of the machine, which necessitated the putting on of laborers; now his mistake has been fully realized, and with a square basis of operation, I think the molder will be very glad to reverse his previous position.

MR. FRAUENHEIM: Mr. Mumford has made the statement that the molders have finally realized the value of the molding machine. These machines have now gained great strength. As they however, have gained strength without the aid of the molder, why call upon him now?

MR. MUMFORD: I am not advocating the employment of the molder on machines until there is absolutely no maximum limit placed on their performance by the molder individually or collectively. If the molder wants to give the machine a square deal,

by all means use him, but only then. In my judgment the manufacturer should never submit to have any restriction placed on the output of any machine he has installed.

Mr. Gale: In my opinion, and based upon my experience, if we could get our expert molders to take hold of the machine properly, the scrap heap would be much smaller. We would also find the output of the machine vastly increased over what is done by common labor. Having this in mind, I tried several years ago to interest my molders in the operation of the machines. I now recall two cases of first class floor molders who were making about 100 molds a day apiece. Putting them on machines for the same castings, and after getting handy, I found the output still the 100 molds. They thought their day's work was done, and could not be made to see it otherwise. Hence our return to common labor. Still, I believe that with molders on the machines, the scrap heap can be reduced.

Mr. Custer: It seems to me that the general opinion of molders about the machine is that the output is to be doubled and made at half the cost. I like to put myself in the other fellow's place. Making thirty molds by hand is to be changed to sixty by the machine. In some cases this amounts to three hundred molds daily. Now the iron has to be carried for this, and it seems to me the limit of a man's endurance is reached before this. He must have help for this. I agree cordially with everything that Mr. Mumford has said, except that a man should receive the same pay for the increased output. (Note by the Secretary: Mr. Mumford may have been misunderstood in this, as he advocated the sharing to some extent of the increase by the molder. Mr. Mumford, however, placed himself firmly on record against the slightest limitation in output by any one running a molding machine.)

Now I have some molding machines in my shop. The work is all of a light character; and hence I get fair returns. Were the work heavier, however, I could not get the output doubled and all the labor performed. It would be an impossibility. It has been stated that we must make our machine operators, but you will find that they cannot make you 100 molds for the same cost as 50 by hand, and pour their iron. You cannot put them on the machine and tell them they must stay there. The

very moment they get an insight into hand molding, they will not stay on the machine and handle iron also. I would not handle pig iron myself, if I could keep books. (Laughter.)

MR. MUMFORD: While the operation of the molding machine forms a large part of the work of machine molding there are other points like the pouring of the iron to be considered, as you will have noticed from the drift of the discussion so far. I have called attention to this in question 4. "What part of the work of Machine Molding is getting sand to the machines, and getting the molds off the machines to the floor, etc." I shall bring this up for discussion later on.

MR. LEMON: Has it not been the history of the country from one end to the other, in fact the history of the world, that where labor saving devices have been introduced, the idea always existed that this would be detrimental to the interests of the working man? I recollect the introduction of the binder in the harvest field. The opinion obtained then that it would do away altogether with the hired help. Today you will scarcely find a man willing to work on a farm not equipped with all the latest machinery. How difficult it is today to keep men—the farmers' boys—on the farm, you all know. We have simply advanced. And so also with the molding machine. The question will solve itself, and I think the time not far distant when you will not get a molder into a shop not equipped with these machines. The people have moved right along. I remember the time in Milwaukee, when the common laborers, then the Poles, were a very poor lot. Today they own their homes, are well dressed, and perfectly contented. There is a gradual development all along the line, and in time to come, the molder will look back and think he was a slave. Anything that keeps a man from hard, slavish labor, elevates him, and the molding machine will be found to be one of these things.

MR. MOTT: In walking through the exhibit buildings, I was very much struck with the operation of the molding machines there shown. How absolutely they are doing away with the duties of the molder. Why even the drawing of the pattern is done by machine now. I saw one machine. The man placed the flask on the machine, rammed it up by hand, turned it over, and—the machine drew the pattern. Here was a grand elimina-

tion of the molder's work. Every other part of the work which was performed, can be done just a readily in your shop without the aid of a molding machine. The molding machine man does not go to New York and hire a Pole just landed and bring him to the exhibition, but takes a first class man at high wages and expenses paid. He is the handy man they show. I was somewhat amused in listening, at the proposed elevation of the molder, so that he soon would not have to work on anything but molding machines, turn out 300 molds a day, pour, shake out, and then go to the base ball game.

It strikes me that the whole thing was begun at the wrong end to a certain extent. The selling department, or business end conceives the idea they have got to sell goods cheaper than anyone else do, and then the manufacturing end gets—I hate to say the word—but that it what they get. Therefore the cost of production must be decreased. You stand, squabble and fight over 5c. on the molding of a piece of work which is going to sell for $10.00, then cut it to $9.00, and say nothing; everybody is happy, everybody satisfied. I cannot understand why the $1.00 on the selling end is not more valuable than the 5c. on the other. To speak of molders opposing the machine. Why should they not? They would be more than human if they did not. The molder of yesterday is the employer of today, and these molders are going to oppose it until they can get a fair day's pay for their work. Your molding machine requires a molder. You can teach your handyman, and then your experienced handyman becomes a molder. Why should he not receive a molder's pay? If you do not give it to him, he goes elsewhere, and gets it just the same.

Excepting certain experiences we have had with molding machines, we today turn out 170 molds where we formerly turned out 100 by hand. The molder gets the same pay as before, and we get the difference. Mr. Lemon spoke about the introduction of the reaper, but did not think for the moment that the man on the reaper gets two or three dollars a day more than the man with the sickle. The chauffuer gets more money than the coachman. The mechanic who does nothing more than put a heel on a shoe gets more than the old shoemaker who sits on his bench and makes a complete shoe.

THE PRESIDENT: Mr. Mott, may I ask if you would make the attempt to define a molder.

MR MOTT: Yes—One who molds.

MR. BERRYHILL: In connection with the auxiliary apparatus which belongs with the molding machine, I would recommend the installation of a trolley system to get the iron to the molds quickly and easily. This will prevent the wearing out of the man. It is not a molder's work to shake out castings and bring up sand. These are problems which must be considered along with the molding machine.

MR. NICHOLS: I would answer Mr. Berryhill by saying that if these things are obligatory, it would cut out about 60% of the foundries of this country.

MR. COWAN: I just wish to say from experience in foundry practice in our own shop we have had very good success with molding machines, but I believe I can substantiate what Mr. Lemon had to say. I started my business life in a printing office, and remember the time when the typesetting machine was introduced. There never was a machine that was opposed more bitterly than the typesetting machine, and, being personally acquainted with a number of printers, I know that they believed the machines were going to be a detriment to them. I know the same men today are operating the typesetting machines; they are succeeding, and the printer is the one who has helped perfect the machine. It will not be long before the molder himself will say the molding machine is here to stay. It is a good thing for the manufacturer today, and experience will prove it to be a good thing for the molder.

NOTE BY THE SECRETARY: At this point, the discussion closed for the morning session. Ex-President W. H. McFadden called particular attention to the fact that the policy of the American Foundrymen's Association excludes anything touching on labor disputes, and hence any allusions as to the attitude of molders toward the machine should not be construed as a reversal of the Association policy, which is entirely educational. President Stanley G. Flagg, Jr., in reconvening the meeting in the afternoon, also emphasized this point, and wished it understood that the Association desired to take no stand on matters falling within the province of other bodies of manufacturers or operatives.

He said further, "I think that you will all recognize that the machine and the operator are each part of the general scheme. It is therefore almost impossible to discuss the machine without discussing to some extent at least the kind and character of the operative. So if you will bear the Association policy in mind in the further discussion, I think we will get more satisfactory results."

AFTERNOON SESSION, JUNE 10.

THE PRESIDENT: Mr. Mumford will be glad to continue if those here are interested in discussing the question of whether a molding machine is better operated by a man who has never before been employed in a foundry and broken in to this machine, or whether it is best operated by a man who has had previous experience at hand work without regard to that man's operation in any sense whatever.

MR. MUMFORD: I want it clearly understood that I do not mean to take the initiative in this matter; I want to simply make suggestions on which others may speak. I don't say that the molder is essential to the operation of the molding machine, but, just as Mr. Flagg has said, I do believe it is the man handling the machine that makes the molds for the castings, and it is impossible to separate one from the other. If we consider the matter from an educational standpoint it is just as important that this Association should discuss the question of (how to handle the molding machine itself) as it is that of (how to handle the man who has to handle the machine), and I hope that view will be taken here.

You will notice that the discussion started on the basis of 10 questions which I had prepared for others to answer, and I introduced an 11th question as No. 1. Now I believe there are some gentlemen present who have some data which I know would be interesting from an absolutely educational point of view as to the operation of molding machines, and I am going to take these questions and go through with them seriatim, wait-

ing for a reasonable time for someone to answer, as I am trying to get as much information on the line of these questions as possible from those in attendance.

1. Is there anything by which to appraise a molding machine other than the ratio of value of castings produced to cost of production? I suppose the answer to that is an easy one.

2. When do portable molding machines pay better than stationary machines, and why? These immaterial points we will pass.

3. When do stationary molding machines pay better than portable machines and why? I will read the next one as there is no discussion on this.

4. What part of the work of machine molding is getting sand to machines and getting the molds off the machines to the floor (a) in hand rammed or portable machines? and (b) in power rammed or stationary machines?

I am quite sure there must be some data here which it would be valuable for this Association to have in regard to what the records have shown as to what proportion of the total labor is the work of handling the sand and the molds produced. I would like to hear from anyone who has any information on that point. Mr. Knight, cannot you give us some information on this?

Mr. Knight: I do not know anything that I could say that would be interesting. We had eight machines. These machines were the ordinary power machines, and were my first attempt at using molding machines. We had better success with those machines than any others that we have had anything to do with. But I do not know as a matter of fact that a molder starting these machines necessarily meant a great deal for their success.

We found there were just two things about molding machines to make them a success: One, getting the sand to the machine and taking the molds away; and the other, pouring the molds off after they had been placed upon the floor. We kept very accurate data in regard to the cost of those operations and how much that made to us in percentage ratio to the total operating value of the machines. I may say the pattern we had on the machines was an ordinary standard four inch soil pipe tee, a thing which probably all of you are familiar with. We were able to work up 300 molds per day, and that included just two

men on two machines, a boy looking after the cores, and one man we had to bring the sand to the machines; then we had a man come in the afternoon to shake out the castings and wheel the sand back again. That made 5 men on these machines all told. Our ordinary hand price for that particular job was 7c., and we made the work for under 3 cents apiece by machine.

But the difficulty came about in that we could not get the sand to the machines, get the molds away from the machines, and get the castings poured off, at anything like the rate we got the molds made at; and in trying to relieve ourselves of those difficulties we found we brought on a great many more complications. We found in rough numbers the proportions of a day's work were about like this: That the making of the molds and core-setting constituted just 50 per cent. of the total work. The pouring off, the cutting of the sand and carrying the castings to the mill, was 25 per cent; and the handling of the sand back to the machines and placing the sand on the machines amounted to another 25 per cent. Those figures were for about a 6 months' run and are approximately correct.

MR. BERRYHILL: We have one man operating a machine all day long, and another man who takes the molds away from the machine, brings sand to the machine and tempers it, making it ready for the man using the machine. That one man in handling the mold material keeps the other man busy on the machine. Then they both pour off; and we have another man who spends about two hours in the evening taking the castings out of the sand and putting water on it so as to have it ready for the next day's operation. Our output is about 200 molds a day.

MR. MUMFORD: Are there any others who have any data to offer? It is a most important thing to be remembered that a molding machine of any price, it does not matter what machine, does only part of the work, and the purchaser of the molding machine should understand fully that he is only covering part of his work.

A MEMBER: I would like to ask of the data Mr. Knight gave, 50 per cent, does that represent dollars and cents or time spent on the job?

MR. KNIGHT: Wages paid.

MR. MUMFORD: What increase of output is afforded stationary

machines by power sand supply over that when sand is shovelled from the heap? I do not know that there are many molding machines where the sand comes to the machine through a conveyor and the molds are not carried away. Generally the saving due to sand conveyance is mixed with the saving due to mold table disposal of the finished work. Does anybody know how much more work can be had when the sand is supplied from a hopper overhead than when the sand is shovelled from a heap?

THE PRESIDENT: I might say a few words on that subject in a general way. I have been in a number of plants operated under what they call the continuous pouring system, and from my observation the more you multiply the number of men the more you multiply the difficulties of operation. Naturally, I think you will agree with me that a more average is the result. If you have a quick man making molds and a slow man taking care of them, you might suppose the quick man would pull up the slow man, but the reverse is the rule. The slow man pulls down the quick man. I have been in shops where they have had very large daily outputs from one machine operated by perhaps four or five men. The output would run up to 10, 12, 13 to 15 hundred molds per day. When you divide that large output by the number of operators you very often find that a much less expensive outfit, a much less expensively operated machine, would produce just as much per man, and of course, in team work, if one man fails or one operation fails everything is stopped. There have been very large concerns held up and their operations almost entirely suspended by reason of some slight accident. Consequently the more you divide up your productive force, the greater the variety of your output, the less serious will be an accident which might occur at one place or another. I do not know whether that applies so particularly to this question, but it does seem to me as if there are some lines of work in which power conveyance of sand and power supply of sand are satisfactory. One of the biggest troubles they have with this is the peculiar condition into which the sand itself gets. I have known some plants where the character of the sand seems to change entirely; they got little pebbles, which they could not break up. Perhaps the clay became separated out and the proportion of silica became too great in the sand. There

are very good results obtained from small conveyors attached to small machines, but I rarely found that if you divide the total output by the number of operators the gain per man was very large.

MR. MUMFORD: Is there anyone else present who has anything to say in regard to this question?

MR. KNIGHT: We found after we got our sand conveyor in working order that our men could manage 800 molds where they could only manage 350 before.

MR. MUMFORD: That is, you doubled, or nearly trebled your output, because you added a sand conveyor and nothing else?

MR. KNIGHT: Not altogether. The sand conveyor proposition is very much as Mr. Flagg said, it is a thing that will bear the very closest investigation before any money is spent on it. It was a matter of a great deal of trouble to keep our outfit in working order. We had to have two machinists on it all the while. The machine had to handle 16 carloads of sand a day. Of course, it meant a strain on the machinery all the while.

MR. MUMFORD: Mr. Flagg also referred to the fact that some machines have sand conveying apparatus a part of them—"small conveyors on small machines." I want to speak of the distinction between sand elevation and sand conveying on a horizontal plane. I distinguish the elevator from the conveyor quite sharply myself, because the bucket elevator has no deleterious effect on the sand within my experience, and it is almost impossible with anything but a belt conveyor not to have a tendency, at any rate at certain speeds, to ball the sand, as Mr. Flagg has said.

Probably a great many have seen the foundry of Henry R. Worthington Inc., at Harrison, New Jersey, where the sand is delivered at close quarters to the machine by sand elevators and where the machine operator has all the advantage of conveyed sand without having to receive his sand from the entire shop supply. Each floor is independent. The sand is simply elevated. The condition of that sand, even roughly as it is treated, is admirable, always.

DR. MOLDENKE: In connection with the conveying of sand, I believe the foundry of the Westinghouse Electric Supply Co.'s Brass Foundry, had quite the same trouble in their reciprocating

conveyor from that very matter, the particles of the clay separating from the particles of silica and balling up, and it was only when they found the proper speed for the conveyor that they succeeded in getting their sand where they wanted it without too much of a change in its characteristics.

Mr. Mumford: I will now come to No. 6. What increase of output is afforded stationary machines by immediate disposal of mold parts, so that the operator does not have to set and close his own work on the floor? The day is coming, gentlemen, when this question of transportation of sand and of molds is going to lie very near to us as competition forces us to get larger and larger output from our machines. Any data we can get now from those who have had experience will be of the greatest importance.

Dr. Moldenke: If you take the trouble to look into the German literature on foundry practice you will find the question of sand conveyance is beginning to form a big point in it. There is no issue of the German technical Journals which does not contain something about some foundry which is beginning the installation of sand conveyor and sand mixing machinery. They are probably just at the transition period and are spending a lot of money, so I suppose we will learn something about it shortly. On the other side they pay much more attention to their sand preparation than we do here, and Germany is doing the largest work now on that very problem.

Mr. Mumford: Then passing over the 7th and 8th, I come to the 9th question: What is the limit of depth and the size of flask at which power-ramming by pressure ceases to pay? That is a pretty broad question.

Then 10. What is the limit of depth and weight of mold at which jolt ramming ceases to pay?

There are a great many more questions which might be added, but these are the ones in print and they have been rather hastily prepared. I want to get back to the question we were discussing this morning.

Now, this morning we were discussing a letter sent me by a friend, a large user of molding machines and who has had great experience with the question of labor, hand and machine, man for man, individual molders and unskilled operators. He learned

what advantage there was from the use of a molder with his long acquired, hardly acquired skill, over the employment of the unskilled operator. This gentleman made the statement that he included in the definition "molder" the handy man who had become experienced on a machine so that he knew all the tricks with the sand and could turn out castings with as little loss as the experienced molder can if put on the machine, or perhaps less.

Now this gentleman stated in his letter a hypothetical case. The object he sought to establish was a fair basis of remuneration for the molder, supposing that the molder were to be put on the machine. We have all, both builders of molding machines and users of them, had experience, with the fact that, in times gone by, a molder placed in charge of a machine was tempted, as Mr. Gale said here this morning, to become overwearied when his machine output equalled his previous hand output. He would keep up a certain rate of 100 molds a day and although Mr. Gale said the capacity of the plant and the man was 300 so far as the molds were concerned, it was impossible to get more than 100 from the man who had become accustomed to 100 molds a day.

Now, my correspondent proposed that there should be selected by the molder, an expert to see what was the best that he could do by hand molding on a certain piece of work, and that then the manufacturer should take a machine and an unskilled, that is a non-molder operator, and see what was the best *that* man could do on the machine, and what the cost of the two methods of operation proved to be. He urged that on a basis of the manufacturer receiving the benefit of the saving of labor due to the machine and the molder receiving wages at least equal to the wages he received before, the price for the molder in this hypothetical case should be determined, called it an automatic wage scale.

We know there is an immense body of experience ready at hand in the trained molders of the shops. We know that molding machines are getting deeper and deeper into the molding field every day, and that merely ramming the molds and drawing the patterns is not the complete operation.

If the man who has had a lifetime of experience is willing to

give the molding machine and the manufacturer a square deal, is there any reason why we should not let that man, willing to give us the square deal, have an opportunity to show what he can do, and if he can lower the discount on the difficult work, or on any work without holding back the product, give him the chance to operate the machine, which years ago he declined to accept?

THE PRESIDENT: Talking on the subject generally, I would like to ask Mr. Kahn if he will be good enough to give us his views on the subject in a general way?

MR. KAHN: Mr. President and Gentlemen: I came here from Ohio for the purpose of learning something about the subject matters before your great and useful organization. My colleagues and I were sure that you would extend the hospitality of your Association to us and on their behalf and for myself, I acknowledge and thank you for the extraordinary and I might say princely courtesy we have received at your hands.

We did not expect to deliver any speeches of our own but rather to listen to yours. The fact is we had assumed that you had solved this great and perplexing molding machine question, and that all we had to do here was to come and hold out our aprons in order to catch and enjoy your wise conclusions and take them home in order to let others, whom we represent, enjoy and benefit from them also. But without reflecting upon your broad intelligence and capacity, Mr. Chairman, I discover that there are many things, that your members have not yet learned about machine molding, and that you are nearly in the same boat with us stove makers. (Laughter.) While I despair of telling you anything new or of a technical character about molding machines, perhaps some of you have interest in knowing that some things about this question have made me hang my head because I do not know about them and that very few people apparently know or understand satisfactorily. When we realize that we have tough nuts to crack, we generally become humble and wise enough to co-operate with others along generous and judicial lines and it is then we are of mutual advantage to each other and that real progress is made.

When I was quite a young man, that has been sometime ago,

I was reading up on the introduction of artificial gas in this country, and I think it was in the City of Brotherly Love, the home of our friend Mumford, where they had riots against the laying of gas mains because it was asserted the old town might blow up whenever the gas was introduced and began to get lively in the pipes. I think similar opposition occurred elsewhere. Some printers concluded that they could bar the imaginary evils of the printing machines against their craft by destroying those introduced into a shop of a western town.

Gentlemen, we are up against the molding machine proposition. We all realize it, I think, but I feel that in the better sense, it is a general rather than an individual question. If I could go ahead in the old way and make molds on the floor and bench as we are now doing and pay respectable dividends to our stockholders, I would not much care about molding machines. The fear that dividends may stop, if we don't produce castings at a lower price, is what's forcing us to think of and take interest in the question.

The need of keeping pace with our competitors, who largely control whether we may have profit or shall suffer loss from our business may be a great stimulant to general progress, but Mr. Chairman, it is also too often the short road to bankruptcy.

The molding machine, like every other great industrial invention or innovation is going to be introduced thru natural or normal evolution and in spite of all opposition; it is not going to come "all in a heap" or a day but it is going to be a slow laborious step by step development and I believe that its greatest direct beneficiary will be the molder, who accepts it in good faith and makes the best of it.

I believe that, viewed from its highest possible development, the molding machine will tend to make molding a gentleman's art as distinguished from the coarse hardship of floor molding and that molders may some day come to the shop in their "Sunday-go-to-meeting clothes," keep hands in pockets and direct the operation of the machines thru other men inferior to the real molder in skill, intelligence and sense of responsibility. I believe the majority of those men who do the thinking for the vast body of molders now appreciate and are disposed as never before to accept the molding machine as an inevitable and pro-

gressive development of their craft and destined to grow further and further in usefulness and practicability—I would like to see that day! I have about 36 years' experience in the foundry and have had a taste of its checkered and varied vicissitudes, but I feel, Mr. Chairman, that the attainment of great results and the maximum good of a molding machine for the boss lies in the happy medium where ultimately all truth and justice abide. We can hardly expect to find it along the outposts where radicalism prevails.

I believe that the man of average intelligence and good faith, who has spent the best part of his life in a foundry, knows best the requirements of that institution and of that work and is, therefore, the one who will prove most efficient and satisfactory in aiding along the determination of the many problems involved in molding by machinery.

Mr. Chairman, we have all listened to this discussion about molding machinery, and as a matter of fact it seems clear that there are scarcely two institutions represented in this or any other gathering where the conditions are alike—where they are not alike, the process or the course that may be good in one shop will not answer or correspond to the conditions prevailing in another shop. We must go slow about it all. As to the trade in which I am engaged, while there may be a lot of good in the molding machine, I doubt it very seriously. Of course I have in mind that when we make a stove we have to figure that there is possibly an average of 250 to 500 pieces to it and that if we happen to be short of the smallest piece among the total number required we get no stove. (Laughter.) Now, that complex variety of indispensable plates is one great difficulty in molding stoves with machinery. On the other hand, in a shop where for example, they make L's or T's or Sleeves, and other castings complete in themselves and there are enough of them to make, then the machine must be, if I may use a slang word "a dandy."

Gentlemen, let us not lose our heads about this molding machine proposition, I glory in the men, who have worked out these molding machines. A great deal of brain work and money has been spent. I have had occasion to investigate the matter somewhat on the other side of the water, and I could not help taking my hat off when I realized how much those supposedly slow-

going conservative men have done in that line of endeavor. We have a great deal to learn. I met many very clever foundrymen, who said they do not want to use molding machines and who gave good and plausible reasons for that opinion. Now, that did not convince me that the molding machine would not be a good thing for me, but it did convince me that I must first examine all matters related thereto very carefully and fully before I adopt it.

The thing that requires closest examination is whether or not I could, as a business proposition afford to do that which would provoke disturbance and destroy the peace of that shop, which would cripple the previous product and ability to execute contracts. I believe it is true of all shops that the peace, contentment and efficiency of the men are worth as much and more than I could hope to get out of a machine.

Gentlemen, that is the view of many of us who are engaged in the manufacture of stoves. Some, however, do not agree with that view of the case. I am afraid too many assume that the molding machine is going to be the greatest redeemer of their freedom and intend to use the molding machine to get rid of disturbing factors in their shops. I believe, that gentlemen, who approach the subject in such light, are doomed to great disappointment. I believe the best way to introduce it, is under peaceable conditions and with a reasonable sense of what they will accomplish and the cooperation of those upon whom we must depend to fill orders and keep the shop running. We came here to see the machines and hear you gentlemen, who have used and those who sell them tell all you know about them in order to report intelligently the facts to our colleagues. Whether we shall succeed, I think, will depend largely upon our own intelligent observation and activity. Let us not forget the Golden Rule. Let us not forget, Mr. Chairman, that almost universally when machine work supplanted hand work, the man in charge of the machine earned as much and more money than he did working by hand. If there is any business in which the contrary is true, I have not heard of it. It is a fundamental mistake to assume that the individual earnings can be reduced because of the introduction of machines. I also believe, Mr. Chairman, that it is an absurdity to assume that when we have made smart

and profitable workmen, they are going always to remain beyond and outside the influence of organizations, which now, for good or bad, undertake to promote the interests of their fellows and for reasons like those that have brought us all here. (Applause.)

THE PRESIDENT: I feel that you will agree with me in thanking Mr. Kahn very earnestly, for the trouble he has taken and for the manner in which he has put his views before us.

MR. MUMFORD: I want to close the discussion of this very interesting topic by saying that it seems to me for the very reason that this, the American Foundrymen's Association, has to do with educational, peace-loving, industrial methods, it is a most important topic for us to take away with us for further consideration, and that it is a very fruitful theme and will undoubtedly be so at future meetings. We know what the troubles have been with labor questions when they are handled butt end first. It is by such plans as proposed in this letter, by an automatic arrangement, that the best ends can be accomplished. I hope to see the role of this Association one in which the highest aims of both labor and mechanism may be served by their joint co-operation, so that all the skill the operator has to offer may be at the service of the machine, and all the saving of back-breaking work that the machine has to offer may be at the service of the operator. (Applause.)

THE PRESIDENT: I do not know that any words of mine are necessary to express our appreciation of Mr. Mumford's work. I do not know how you look at these serious questions, but for fear you may consider them slightly academic I, for my part, will say that I believe they are fundamentally necessary to be solved before we can make up our minds in an intelligent way. Most of us, in fact all of us, who have attempted to solve the molding machine question, have done so, as Mr. Kahn plainly stated, along the lines of our own experience. Until we can lay down something that looks like a law, a fundamental principle, it seems to me we cannot hope to make any progress which will be generally accepted. Practical men all have different experiences, and if their judgments are based on their experiences it seems to me their opinions must all differ. Something of this sort is necessary to collect our ideas and experiences and

give us the ground work or starting point to some positive, reliable development.

For fear that I have already said too much, I hesitate to add more, yet I beg the privilege of the "last word" usually allowed the man who has had the first word, that he may weigh and use collectively for the enriching of his message to the meeting the voluntary contributions of many minds, silent but that he had spoken.

Just as no single speaker in a discussion of this sort epitomizes the sense of all present, so we here—even all the wisest in 1908—can only, as Mr. Kahn has said, "simply help along a scientific or mechanical innovation," and, as Mr. Lemon has said, observe that "the question will solve itself." Like all social developments, the brilliant, lucid, perfect sphere of final form will be for machine molding what it has been for many more difficult problems, the crystallization of the thoughts of many minds from many nuclei.

When an advanced method is adopted in a foundry, it affects directly the duplex status of that shop the two parts of which are as co-operative as the two sides of a duplex pump.

These two parts are,

1st. The men who work for wages.

2nd. The individual or corporate owner of the business who makes it possible for these men to work.

If either part is injured by, or either part receives much more than its share of benefit from the new method, this duplex mechanism,—a foundry,—works unevenly. If it were a pump, it would be said to "kick."

I have enough faith in our molders as men and in our foundry managers as men to believe that all of them accept these facts.

Yet, such has been the history of molder and foundryman that each is watchful, aye, and fearful lest the other get more than his share of benefit or less than his share of preliminary hardship when improvements are tried out and then, if successful, adopted.

Now, when a man fears attack, he picks up a club or he calls

for help. If he's giving his attention to business, he does neither.

The business of the molder and the foundry owner is the same,—to make castings.

The molding machine is simply a new tool in the old art.

Experience shows that, by time and cost, molding machine operators may be trained and, as Mr. Mott has said, become molders. But such men's capacities are limited to specialties.

However, molding machines are less and less limited to specialties as time goes on. They are becoming more and more tools for the trained molder in his full repertoire of work.

A skilled man can always use a good tool better than an unskilled man and get the same results with less loss and labor.

It was with the idea of helping to a so natural and easy position of the skilled man on the molding machine as to achieve the ideals of Messrs. Lemon, Mott, Cowan and Kahn that my correspondent's suggesting a working arrangement was written and made the basis of the main part of this discussion.

As I read carefully and at leisure the remarks of all who have spoken and as I meet, as I do, the molder and the manufacturer in the foundry, I see no reason why I should not say that I find them almost all ready, over the grave of a dead past, to push on to great and unknown possibilities in which men and machines, untrammeled by dissension, labor for the best that both can do.

The president appointed the following members as a committee on nominations: Mr. H. E. Field, Chairman (Pittsburg), Mr. N. B. Shaw, (New England), Dr. E. E. Brown, (Philadelphia), Mr. J. P. Golden, (South), and Mr. David Reid, (Canada).

The Secretary then made some announcements regarding the visiting of plants, and gave brief abstracts of the papers of Messrs. Carr and Diller, who were not able to be present.

Mr. Thos. D. West was then given the floor, and read his

paper on the Prevention of Accidents in Foundries. (See page 27.)

DISCUSSION OF THE PREVENTION OF ACCIDENTS IN FOUNDRIES.

Mr. Bell: I wish to thank Mr. West personally for the interest he is taking in this matter of drawing attention to the danger of accidents in foundries from carelessness and other causes. He has also cited the lack of safety devices. Now within the last few weeks I have had one of the most remarkable incidents that I think has ever occurred to any of you or in any foundry. It came about in this way. I have a young man working for me in the foundry. He is capable of doing a good day's work without showing any traces of fatigue, and he has a helper working with him. One day I went into the shop and discovered the helper was not working along with him that day, and asked him what the reason was. He told me that the helper had had to stay at home that day in order to have an operation for rupture performed upon him. While he was giving me this information he was standing opposite a ton weight. He was describing the operation to me, moving around while talking and not watching very closely, when all at once he threw up his hands and fainted, and in falling his head came within 3 inches of striking that ton weight, and would have killed him almost immediately as everybody knows here what the result of a fracture in the base of the skull is. That is an accident that I do not think many of you have ever heard tell of in a foundry. What particular thing would you attribute the causes of such an accident to, if it had occurred?

The President: This is your story.

Mr. Bell: Was it carelessness on the part of the foreman to bring up a subject of that kind, or was it carelessness on the part of the employee in allowing his physical condition to get down so low, or was it carelessness on the part of the management not to see that their employees were in better physical condition? Now, which was it? These are questions that we have got to analyze. Now, for fear that some who are present here may

possibly be affected by the serious and ghastly things that have happened in foundries and might happen, I won't undertake to describe them. (Laughter.)

Mr. A. W. Loudon then read his paper on Core Sands and Core Mixtures. (See page 19.)

DISCUSSION ON CORE SANDS AND MIXTURES.

THE PRESIDENT: I would like to ask a question. Mr. Loudon, do you make any changes in these mixtures with various sizes in the grain of the sand? That is, do you make the same mixture for small sharp grains of sand, as for large ones? Do you notice any difference in the operation of different sized grains in the case core?

MR. LOUDON: From my general experience different kinds of sand require different amounts of binder. What I have given here is just what I am using in the foundry with sand peculiar to my locality. In going into the different places and talking with different men who have charge of foundries, if I were to do the same as they do with what I have got I could not get results at all, because I have gone as far down and as high up as there was any necessity without getting bad results on either side. Take Lake Ontario sand. It is quite close to us, and then compare with a sand 300 or 400 miles away where we would probably get a bank sand, and while we may use the same oil to bind the two sands the quantity required would have to be entirely different.

A MEMBER: Coarse or fine sand?

MR. LOUDON: The quantity would have to be different, that is, you could not use as much oil in one sand as you could in the other.

A MEMBER: The coarser the sand does it require more oil?

MR. LOUDON: I expect so.

MR. CHENEY: In the proportion of mixing your binder with the sand has the manner in which the binder is put in got as much to do with it as the nature of the sand itself?

MR. LOUDON: I would feel that the way the binder is put in is just as important as the amount. With mechanical methods

of mixing sand we can reduce the amount of binder, but we are placed at a disadvantage in small foundries, because we don't all have these nice things. The hand operation results in the raw material forcing us to use more binder to get the same results.

MR. CHENEY: My experience may help some of the others. I might say I have used a riddle and am now using a mud filling. I find mud filling saves practically 25 per cent of the binder and makes quite as good and strong a core. I also notice that my core makers when trying new oil or a new binder are very particular on the bank sand. They will make a core fully as strong and as high as one to 80. But the majority work through the riddle and do not get the binder ground into it. I think that is the secret of the low ratio with your binder. The mill I have has a roller in it about 3 feet in diameter and when it has gone through there the oil is bound to be evenly distributed all through, and therefore there are no globules.

THE PRESIDENT: In other words the better you mix it the less binder it takes?

MR. CHENEY: Yes.

The Secretary then read his paper on Titanium in Cast Iron (see page 57), and spoke briefly on the papers of Messrs. Saunders, and Taylor. Mr. F. C. Everitt then read his paper on Modern Foundry Warehouse Methods, which was very complete, and hence not discussed. (See page 23.) The meeting then adjourned for the day.

MOONLIGHT EXCURSION ON THE LAKE.

On the evening of the 10th, an assemblage numbering several thousand gathered at the pier of the Niagara Navigation Co., by invitation of the Canadian Manufacturer's Association, to enjoy a moonlight excurison in the harbor of Toronto and on Lake Ontario. The magnificent steamer was comfortably filled with happy people who enjoyed the delightful trip. The Highlanders discoursed sweet music, and occasionally the pipers would march through the ship and arouse all the latent patriotic fervor of the Scotsmen present. The ladies were presented with To-

ronto's finest candies, and a good opportunity had for pleasant visits and renewal of old ties of friendship.

To the Eastern members, accustomed to the white and gold of our Sound steamers, the beautiful interior of Flemish Oak was a most agreeable and restful change. There were no liquid refreshments served, the management of the Canadian Manufacturer's Association, the Toronto Committee, and the Executive Board of the Association agreeing fully on this point.

About eleven o'clock, the prow of the steamer was turned homeward, and a tired but happy crowd slowly wended their way Hotelward. The Manufacturer's Association had earned the hearty thanks for all who had attended.

MORNING SESSION, JUNE 11th.

The President called the meeting to order at 10.40 A. M. The papers of the meeting were practically all on Cupola Practice.

THE SECRETARY: Mr. Stupakoff's paper, which you have up first this morning is a very deep discussion of what goes on in temperature and other heat questions in the cupola. It will pay you to study it carefully, as Mr. Stupakoff is an authority on pyrometry, and a man of painstaking and unremitting labor in his chosen field.

DISCUSSION ON CUPOLA PRACTICE.

NOTE BY THE SECRETARY: Before giving the discussion attention is directed to another paper by Mr. Jules de Clercy which was handed the Secretary at the time of the meeting. This is published in full on page 103, and amplifies Mr. Bacque's remarks to such an extent that a considerable portion of them is therefore omitted. (Mr. Bacque is Mr. de Clercy's representative). Further, at the close of the Convention Mr. Bacque was good enough to hand the Secretary a report of the test runs made with the Balliot Cupola on the Exposition Grounds. This is given herewith for the information of the membership, and will especially interest those who saw the trials. He writes:

"Herewith you will find the figures for the different runs we

have made on the Balliot Cupola, since the beginning of the Exhibition, viz.:

Monday the 8th of June, 4 P. M. to 5.30 P. M. ..... 5,000 lbs.
Tuesday, the 9th of June, 3.30 P. M. to 5.30 P. M. ... 6,500 lbs.
Wednesday, the 10th of June, 3.30 P. M. to 6.00 P. M. melted 10,000 lbs. Stopped for 1 hour and went on from 7.00 P. M. to 8.30 P. M., 6,000 lbs. ...16,000 lbs.
Thursday the 11th, 3.30 P. M. to 5.30 P. M. .... 9,000 lbs.
Friday the 12th, 3.30 P. M. to 4.30 P. M. .... 4,000 lbs.
Saturday the 13th, 3.30 P. M. to 5.00 P. M. .... 8,000 lbs.

I might say that on the first two heats particularly, and during the whole time, to a greater or lesser degree, we have worked under a heavy handicap for want of molds to pour, space to work in, as well as all the other small troubles incident to an exhibition of this kind.

In spite of this we ran the little cupola every time with 520 lbs. coke for the bed, and 75 lbs. coke to every 1,000 lbs. metal. We found that we had used too much coke every time, but desired to run safe. The iron reported dull on the first day, only appeared so because the sun was shining full on it. After the place had been roofed in, the iron was reported "hot enough" by the on-lookers. In fact what we poured for ourselves had to be held a while before pouring. Our blast was 5 to 7 ounces all through the heat."

As the calculation of the above runs do not show particularly high ratios, the Secretary communicated further with Mr. de Clercy, giving him an opportunity for additional comment. Mr. de Clercy writes among other things: "We made the runs as reported, regardless of the results on coke consumption, in order to make the hottest iron, so that it would be adapted to the requirements of the molding machine men, who had to carry it very far.

"The iron we got was too hot—in fact in some cases, was burnt. Moreover, the runs were short and the coke and iron not thoroughly known to us. Similarly the cupola, which being less than two feet in diameter, might be called very small. On larger cupolas and greater runs we do infinitely better. At the end of the week the cupola was in practically the same con-

dition as in the beginning, not having been touched or cleaned during the whole time. There was absolutely no sign of any rim of slag around the tuyeres either."

Mr. West: Mr. President, I think it would be very much to the advantage of the audience, if we could have a description from our friend as to the shape and dimensions of the inside of his cupola. There are several points involved that would help us in the discussion. He has certainly proved, I think, by demonstration to us, while here, that he has got something that will bear investigation. There is one part of his paper where he says: "This carbon monoxide may be seen burning as it passes the charging door where it finds the air required to burn it; or else, whenever the draught is weak, the gas not finding sufficient air in the stack, burns only at the top of it, where it spurts into a large sheet of flame," and so on.

I would like to ask Mr. Bacque about how much of this carbon monoxide he thinks he is using there, or if he attempts to regulate this to a nicety by those openings. I would state in noticing his cupola yesterday, that there was a considerable escape of this carbon monoxide. There was quite a flame there. I remember when I first got interested in the question of upper tuyeres along in 1886, designing a cupola with a double row of tuyeres and valves so as to regulate the upper tuyeres in order to find out what was being done in the matter of burning this carbon monoxide before it approached the charging door. I found by manipulation of the tuyeres you could reduce your flame so you could get in and sit on your charge, there being no flame and heat to speak of, showing that we did burn this carbon monoxide down at the bottom. I think we probably burned more of it than what our friend did in his case, but we would not certainly keep the tuyeres of our cupola open in the manner he has demonstrated to us he has done. The cold blast going into the tuyers at the entrance just as he describes in his paper would soon bung us up, and he has quite an achievement there in the way of showing us how to continue the operation of a cupola for a considerable time, especially in such a small cupola as he is running there. But I do think if we had a little description of just the inside to show more of the arrangement of his tuyeres, and the height of the bed above them, it might help us in this discussion.

Mr. Bacque: As to the inside of the cupola, at the charging door, the diameter is 26 inches, and that is just at the level of the top of the recuperating ring, and the recuperator is slightly conical there, about an inch on each side, so that the diameter at the foot of the recuperator would be a couple of inches more, 28 inches. Then the cupola goes down straight to the bed where there is a slight offset, and it is narrowed a little. This is done more with a view to a saving in the bed, you have less diameter to hold up. If you observed any carbon monoxide burning at the level of the charging door, it is due to the fact that you either came when the cupola was low and the bottom about to be dropped, or when the charge remained in suspension for a time, owing to sand stone, which had been sent by mistake, being inadvertently allowed to be thrown into the cupola, instead of lime stone. Under such conditions only, will flames be seen at the door.

If the gases at this level are charged heavily with carbon monoxide, the advantage of returning them to the tuyeres is self evident. The aim of the process, however, is not so much to make use of the carbon monoxide over again as to prevent it's production as much as possible, by ensuring perfect combustion in the melting zone.

It certainly is possible to obtain good combustion, in any ordinary cupola, properly constructed and properly run, by using two rows of tuyeres but, as you correctly remarked and observed, the upper tuyeres are usually blocked quite rapidly by the slag. The object of the process in returning the gases to the tuyeres is also to prevent the burning out of the linings and the obstruction of the tuyeres which is a consequence of the burning and fusion of the linings. There is no particular object to be gained by regulating the mixture to a nicety.

The height of the stack has no importance as far as the process is concerned; it should simply be sufficient to prevent the gases from escaping through the charging door, instead of being drawn up into the stack.

Mr. Hull: I notice in the paper it is recommended to introduce vapor steam or carbonic acid for the purpose of taking away heat at the tuyeres to reproduce it higher up. Now, it appears to me, there may be some argument as to whether this is

a good practice. Personally, I think where we need the heat is at the tuyeres, and anything that tends to bring the heat down instead of forcing it up tends to increase the value practically. On this line Mr. Gayley has increased the production of blast furnaces some 20 per cent, by abstracting the moisture from the air in the hot summer weather, and all blast furnace men know that furnace production is decreased very much in the summer months just on account of the introduction of steam or vapor in the air at the tuyeres. This produces de-composition of the water, reduces the heat at this point and returns it again further up in the blast furnace. Of course, the blast furnace is not a cupola, but it is a question in my mind whether this heat is recovered at all, whether the gases are not wasted by combustion either at the door or at the top of the stack as mentioned. I would also like to ask the gentlemen if any analyses of gases have ever been made from the down comer in his cupola to determine how much carbon monoxide and carbonic acid did back in through his ports.

Mr. Bacque: The idea of injecting steam and gas is to equalize the heat through the whole bed, to drive some of the heat towards the centre of the bed where less air reaches under ordinary circumstances. To illustrate how this blowing in the steam and the carbonic gas at the tuyeres lowers the heat there and raises it further in towards the centre can be explained in this manner:—Take a hard coal fire and open the doors under the boiler and let it burn just by means of the draft. You will not see any flame at all, or so little that it is not worth talking about. Now, if you close up your ash pit and doors and blow in air by means of a steam blast you can make a flame two or three feet long. The action claimed in this case is absolutely the same in the cupola; it lengthens the zone of the heat in towards the centre, whereas all the high temperatures are in the outer cylindrical part of the cupola while the centre gets scarcely any heat at all. (Mr. Bacque here explained the temperature conditions in the cupola as given in Mr. de Clercy's second paper—page 103.)

Mr. Long: What about the analyses of the gases?

Mr. Bacque: In this country we have not made any, but they have been made.

Mr. Spencer: It seems to me that the flames at the stack might be caused by your putting through so much air that the gases have been diluted too much. The same thing has happened in so-called smokeless combustion furnaces. Would not that same thing apply in this instance if you did not have some definite means of knowing how much air is flooding in and how much gas there is?

The President: Whether or not an excess of air does not abstract the heat in passing out? Is that the main point you are making?

Mr. Spencer: If you have no definite means of knowing the amount of gas, how do you know the amount of air which ought to be injected?

Mr. Bacque: The burnt or half burnt gases escaping from a cupola cannot be properly compared to a natural gas. The proportion of the former contained in the blast may vary from 10% to 30% of the volume of the blast without general results being in any way sensibly affected. The quantity of air is calculated in the same manner as for any ordinary cupola, because the quantity of air to be added to the blast to burn the gases does amount to 3% of its volume and is therefore a neglible quantity. The case would be different, however, if a rich gas were alone being injected. An excess of air is also to be avoided.

Mr. Lesch: Does this device compensate in any way for the trouble we all have with bad charging? Now, I believe if an ordinary cupola of any kind be properly constructed and properly charged with 10 pounds of iron to one pound of coke, the charges are put in right and the proper volume of air is delivered at the proper pressure, giving you approximately 33 cubic feet to melt down a pound of iron, you would have no flames at the door or at the top of the stack until the last of the charge has descended two feet below your charging door. That has been my experience. If we can get the right kind of coke, of the proper chemical composition and physical structure; and if the iron which is broken to the proper size for proper charging, and then so placed in the cupola as to furnish the proper amount of obstruction to the blast so that you have a proper pressure in the cupola; you will have no flame at the charging door and no flame at the top of the stack. I have seen dozens of cupolas

running all the way from 24 inches up to 100 inches in diameter operating as much as 8 hours constantly without a sign of a flame at the charging doors or at the top of the stack after the blast has been on for half an hour; until after the charges had descended two feet below the doors and the consequent obstruction to the passage of the gases had been removed.

Now, will this arrangement in any way compensate for the advantage which we get by good charging, where you have open chimneys in your cupolas, and particularly when a fan is used instead of a blower? Will this in any way whatever relieve us of this eternal question of men on the charging floor who either do not know how to put the iron in, or will not put it in the way it ought to be put in; that is, keep the charges level and close, so that instead of blowing three times as much air as ought to be blown through, if you are using the fans particularly, you will get the right amount from the right fans and at the right pressure. If we get such conditions, then some of the most considerable problems will have been solved.

Mr. Bacque: I believe I explained away part of these objections when showing how the gases acted, by means of the diagrams. It is an undoubted and uncontradicted fact that good results and complete combustion can be obtained in an ordinary cupola, properly constructed and well run, as Mr. Lesch claims but, as he also adds, just as soon as an obstruction is formed to the descent of the charges, the action of the whole cupola becomes irregular and incomplete combustion is the immediate result of these conditons. This is just the case in all large sized cupolas, however, because the air of the blast can never reach the center of the fuel column, a condition which results in the breaking up of the charges, in their falling irregularly and in the formation of a number of holes which make good combustion an impossibility. This very state of affairs, as I explained just now with the diagrams, is avoided by the blowing in of the gases, their tendency being to thicken the zone of combustion towards the centre of the cupola. I might also add that increasing the height of the cupola, is not, in itself, sufficient to reduce the quantity of carbon-monoxide present in the products

of combustion; they are merely cooled down to such an extent that it will not ignite and is none the less lost to the amount of heat available for useful work. The bare fact of there being no flames visible at the charging door cannot, therefore be taken as prima facie evidence that the cupola is running properly and economically. And then again, it cannot be claimed a cupola charged with all the fuel on one side and the iron on the other, is going to be made to run satisfactorily by the mere addition of the burnt gases to the blast. Any cupola can be made to run unsatisfactorily under such conditions.

What I do claim is that the addition of the gases to the blast will reduce the chances of accidents of the nature of those described just now, and having a tendency to cause the charges to come down irregularly. But errors can be made when adding gases to the blast as well as when not adding them; they can always be made, under any circumstances.

Now, as to the gases burning or not burning at the charging door; this is a question of temperature. Being present, they will burn if the temperature is high enough and will not burn, if the reverse is the case.

Mr. Kahn: The question in my mind is, what is the temperature of these gases passing through the pipes back to the fans, and what effect will these heated gases have upon the fan?

Mr. Bacque: In reply to that I can say there are about 320 of these plants put up, already, and in most cases they are large plants, run with positive blowers. The gases usually run from 70° to 100°, and there is no injury to the blower. I have been asked that question several times, and can state that I have never heard of a single case of damage to the blower from this source. It has been objected also by some people, that the sulphurous gases or the dust would deteriorate the fan or blower, but as to the first I have not heard of any damage on that account, and as to the second, the dust, the ring is designed to stop all that, and does so in practice.

Mr. Loudon: I would like the analyses of the gases coming down the flue to the blower.

The President: It has been answered that there are no analyses available.

Mr. Bacque: Mr. Loudon, I believe you were there last

night, and I pointed out to you how gases were being wholly drawn in and how, under varying conditions the composition of these gases might vary the analysis of these gases, in any event, is quite a secondary matter, since their composition varies so much. Some times, they may be seen burning with a blue flame as they are drawn into the blast pipe, but most of the time nothing is seen of them.

I may say, here, that when too much of these gases is being drawn into the blast, the slag may be seen passing in front of the upper tuyeres with a mossy appearance, instead of remaining semi-fluid. This mossy appearance is evidently due to the expansive force of the steam which forms bubbles between the molecules of the slag.

Now, I will only add that in blast furnaces it is a prime requisite that carbon-monoxide should be produced and that explains why it is an advantage, in this case, to have dry air in quantities insufficient for complete combustion blown into the furnace. In a cupola, carbon monoxide is no use and should all be burnt to CO^2 to the fullest extent possible.

MR. LOUDON: Does the more flame going in mean the more carbon monoxide present?

MR. BACQUE: Certainly, the flames are caused by the carbon monoxide burning to carbonic gas and this latter gas is the one which is drawn into the blast and by its action contributes to the equalisation of the temperatures throughout the fuel bed.

MR. LOUDON: It won't promote combustion?

MR. BACQUE: Certainly not; but it is broken down to carbon monoxide in the fuel bed and so, produces the desired effect.

MR. LOUDON: It requires heat to break down this carbonic gas?

MR. BACQUE: Yes; and the effect of this absorption of heat is to lower the temperature at those points where it is excessive, to raise it elsewhere, where it is deficient and so to equalise the general temperatures throughout the whole mass of fuel.

MR. LOUDON: It would take quite an amount of heat to break up the carbon dioxide, to form the monoxide?

MR. BACQUE: I have just admitted that it does that and that the effect of it is to equalise temperatures generally in the fuel bed. Instead of having an excessive temperature at one

point, the carbon dioxide breaks up where it is excessive and burns as carbon monoxide where the temperature is lower, and that equalizes the temperature of the whole mass.

MR. WEST: In banking your cupola to delay an hour or so in the melting operation, the same as was done last night when you got through a heat and cleaned out the cupola, and let the fire stand there ready for another heat. Do you do anything different than could be done in any other cupola?

MR. BACQUE: There is nothing different. I have met a good many gentlemen here who have done the same thing.

MR. WEST: But you have an advantage by keeping your fires open in not having the cupola bunged up. I think that is a big advantage your cupola has.

MR. BACQUE: It certainly does facilitate matters. I understand from a number of gentlemen here that they have done the same thing in their works, in ordinary cupolas.

FURTHER NOTES ON SANDLESS CASTINGS.

BY DR. MOLDENKE.

Mr. Lamb telephoned me at the last minute that he was detained in New York and hence requested me to explain what there was to be said on the above subject. Having been present at all the tests made, the results will doubtless interest you.

I will say at the outset that I am not interested in the process in any pecuniary way. Have received no fees for any work done, and aside from personal friendship for Mr. Lamb, have given my time and attention to this matter in the interest of the Foundry Industry, as I saw a tangible solution of a problem on which a good many of us have worked for years. I had solved the problem of casting into iron molds my own way a number of years ago, but when Mr. Lamb brought out his method of taking care of the expansion and contraction strains, which I had to care for by easily crushed cores, I promptly requested him to bring the matter before us for the general good.

A number of years ago I had arranged for casting car couplers into iron molds, and did this so successfully, after the usual preliminary failures, that some 850 of them went into service.

Had the mold not been purposely ruined (23 of them would have done away with three quarters the molders in the shop), very probably several thousand could have been cast without detriment to the mold, or at least before repairs would have had to be made.

The three foot coupler simply has to be provided for its end contraction, which was done by a weak core, and the mold has to be used quite hot.

By referring to Mr. Lamb's last year's paper on the subject, you will get the details of his construction, since considerably improved.

A few days before I came here for the convention, I witnessed the final test made in New Haven. There were twenty of the iron molds for brake shoes arranged in a circle for casting purposes. The arrangement was such as would be used with a casting table in actual service. The brake shoes were of the M. C. B. Type, which required a core in the back for placing a key to hold the shoe to the brake head. This core was replaced by a small iron wedge, afterwards driven out while the shoe was still red hot, by simple tapping with a hammer. Seven brake shoes were cast per hour per mold, and the first was as good as the last. The work went off remarkably smooth, the castings were immediately placed into a soaking pit, and considering the fact that the mixture was 30% pig iron and the rest brake shoe scrap, a very fine set of castings was obtained.

The silicon in the mixture was kept at 2.25 leaving the castings with about 2.00, and this gave a dense close grain, with but a touch of white around the corners. Shoes made with the same mixture at a former test, when sent to Purdue University for official test, gave excellent results, and received high praise. This is natural, as making cast iron with a dense structure and still having it gray in fracture always gives material which wears finely in service.

MR. RUDD: What is the cross-section or thickness of the iron mold in question?

DR. MOLDENKE: Practically that of the brake shoe. This is an interesting matter. If you make the mold too thin, it cools too quickly and is liable to warp. If you make it too thick, it

cools too slowly. The solution arrived at was to make the mold as thick as the shoe.

MR. LESH: There is a small lug on the M. C. B. shoe, about three-eighths of an inch thick. Did that chill white?

DR. MOLDENKE: No. When these lugs were broken off from any of the shoes, they were found a little more white around the rims or edges than the shoes themselves, but they were gray inside all right. I took occasion a few months ago while in California to note a brake shoe which had been taken off our Pullman, evidently for an exhibit. It was blue from the braking friction, but practically a sponge. I was very much surprised to note that the Rail Roads accepted such a foundry product. Now these shoes cast into iron molds were perfect as to surface, as well as interior, and this doubtless because attention was given the cupola practice, so that in spite of the very inferior scrap used, they would show good results. Also of course the fact that the much faster cooling would tend to more solid metal anyhow. The shoes moreover did not even have the markings found on many car wheel treads. They were perfectly smooth. If broken hot, they went easily. But after they were put into the pit while red hot, covered up, and taken out in the morning, it took a heavy sledge to break them, and they could be dented deeply by the hammer. Mr. Lamb has found that the castings by continual application, tested by a steel template, do not vary a sixty-fourth of an inch.

MR. LESH: I am familiar with the annealing of castings such as you speak of, having cast many thousands of tons of brake shoes and other castings myself. The general supposition is that anything is good enough for a brake shoe, which should not be so. The annealing you mention should do away with much of the hardness, and further the composition of the mold should be as nearly the same as the metal poured into it as possible. From the steel men, we also learn that the phosphorus should be kept way down. Hence watching these items, I see no reason why castings of this kind should not be used more than they are.

DR. MOLDENKE: I agree with you fully on this. We not only want the chemical composition as nearly the same as we can get it, but also the physical structure. Hence it is wise to use the same metal for both mold and work. The lower the phosphorus, the higher the melting point, other things being equal, hence

the advisability to work toward the lower phosphorus ranges with the molds, if it is not practicable or advisable to use the same metal for them and the work.

MR. LESH: I am a little skeptical on the wearing quality of the shoe with the silicon high enough to stand this process, because the effect of a chill in iron that runs 2.50 silicon could not extend very far below the surface.

DR. MOLDENKE: To explain this I will say that I made a number of mixtures for the cupola runs, the silicon varying from 1.75 to 3.00, and also with varying proportions of steel scrap, and scrap shoes that had in them steel backs. Typical shoes made of these mixtures were chipped to expose their fracture, in order to compare with the composition, especially the silicon and total carbon. The 3.00 silicon mixtures were entirely too soft, the iron being mushy, but the 2.25 mixtures, giving about 2.00 in the castings (which would correspond to 1.50 silicon when cast in sand) gave excellent results, especially when the total carbon went down from the normal somewhat. The results of the running tests made at Purdue University, showed an excellent conformity with the specifications of the Master Car Builders' Association. This evidently due to the density of the material. When broken these shoes were just as dense in the interior as near the surface. The high silicon shoes were, however, not so, and these shoes applied to actual train service produced a car mileage against the steel insert shoe, allowing 100% for the steel insert, of 94% for the plain cast iron.

MR. STODDARD: A difficulty experienced is the warping of the molds. My observation indicated that this is one of the great difficulties with permanent molds of iron. What are your observations as to this?

DR. MOLDENKE: I rather feared this also, but proper designing, as Mr. Lamb has demonstrated, has obviated much of the danger. I watched the molds particularly for this, and noticed that while they fitted very nicely when pouring was begun, they opened up almost as quickly as the metal had set—due allowance being made for this—but when the molds were opened up altogether to take out the castings, and these were removed, the molds closed up all right again. There was no warping to be observed in any of the molds, several of which had hundreds of

castings made in them. Probably if care is not taken, and the molds are allowed to get red hot and cool off, doing this repeatedly, the condition as well described by Mr. Outerbridge, of the growing of iron, will come to exist, and then trouble will most certainly arise. However, the trick is not to let the molds get just that hot. Also to keep them hot continually, by pouring just so often. This effectively prevents the warping spoken of. Probably the only defect I noticed was the tendency of little spots or flakes to come out of the surface of the mold where the iron laid against it. Eventually this would destroy the mold, but the inner surface could be readily replaced without scrapping the mold, by proper design.

Mr. Cowan: I would like to say on this subject of cast iron molds that we have a gear that is cast on a wrought iron shaft, and the teeth on the gear are ¾ of an inch and the face is about 2½ to 3½ inches across. We have been making them in cast iron molds, of several parts, as we have to make them so that we can open them up three or four different ways to get our gear out afterwards. We originally made two of these molds to try them out. We have since used them a number of different times and we have not yet seen any warping, but we find we have to pour in the iron about twice to get them to the heat necessary for the best results from the mold. We have just completed a line of them. It is necessary to use six of these gears on a shaft and sometimes four. We have them set on a frame where we can adjust the molds to the position we wish to have them. We have been getting very good results from them.

The President: In response to what Mr. Lesh said about silicon, I find in malleable practice that it does not matter what the silicon is provided your fracture is all right. In other words if you get a white fracture with high silicon you get just as satisfactory results as if you got a white fracture with lower silicon. Just what bearing that would have on a car wheel I do not know. You can make your iron white mechanically and get just as good results as if you got it white chemically. The better way perhaps to state my point is that I should think if you made a car wheel sufficiently white under the influence of a chill you would get just as satisfactory a casting as if you reduced the silicon or whatever way you work the chemical. Now, there is

a gentleman here who has not said anything, a gentleman who has been a wide observer and who has had some work along this or kindred lines. Dr. Brown of Philadelphia.

DR. BROWN: Mr. President, my experience with chills up to this time has not been satisfactory. Probably because I was not up sufficiently in the metallurgy of the metal part as I should have been, or as indicated by the talk here today. We have been watching it in a number of foundries and they have had uniformly unsatisfactory results with chills.

DR. MOLDENKE: On this matter you brought up about getting the iron white mechanically, there is one difference that I have noticed—you had perhaps smaller lines of casting in mind while I have had more experiences with the heavy lines of malleable casting—it does matter a little bit about the silicon. If the silicon is very high and you chill, you strengthen artificially and the casting is not quite as good as if the silicon were low and got its strength in a natural manner. I saw knuckles years ago made by one of the malleable companies which was sold as steel. I was surprised on breaking it up to find that it was nothing more than malleable. When I hunted over the surface I found it had been plastered with chills in the mold.

MR. LESH: I think our President is apt to be misunderstood. Of course, we all realize that if you get a white fracture mechanically it is practically the same thing as if you get it chemically, but I am sure he would not be understood that you get a white fracture without the proper chemical constituents, because we know that is impossible. The section of course would determine how far you would go in the silicon, or the other elements which make for the condition of your carbon being all combined. In fact, a white fracture simply amounts to the carbon being all combined. If your section is so thick that a portion of the carbon will turn over into graphite, then it is impossible to get your white fracture. With the silicon taken so that the section determines very largely the character of the fracture—in fact I think we are coming more and more to realize that the basis of our business is after all simply a question of chemical analysis of the metal, and the way you treat it after you have it cast. We are coming to realize that the secrets in the foundry business are rapidly passing away, in fact that we

have no more secrets, or at least, there should not be any, because you can take any casting that is made to the laboratory, get the analysis and duplicate it, and I care not what the iron is, whether sheet iron or scrap, or where the iron is made, whether in Toronto or in Timbuctoo, if you take the same chemical analysis, and give it the same treatment in the cupola or furnace you will produce exactly the same casting; and that is all there is to it. (Applause.)

THE PRESIDENT: In further amplification of my recent remarks about chilling iron, I might say the test bar which we made was an inch by three quarters. Those of you who understand the malleable business know that that piece under normal conditions —there was 2.75 of silicon in this would have been perfectly black, and when annealed perfectly rotten. We set chills in one mold and with the same ladle of iron we poured other molds without chills. We broke a bar without the chills, it was perfectly black, a nice piece of machinery iron. The other chilled piece annealed perfectly and showed a nice rim of white. In the heart it was simply white mechanically instead of being white chemically. This is what I had in mind.

As to permaennt molds, I cannot add very much to the knowledge which most of you seem to have, except to throw out a new line of thought. I do not like to quote Germany, because that is the doctor's specialty, but I might say Europe—sometime ago I became the possessor of some very fine photographs of a machine for making soil pipes in Europe. It was a most complete arrangement by which they closed the molds and poured the casting, and it showed the successive stages of the closing, the pouring out, the opening, the re-closing it and so on. But the thought I want to bring out is that they did not want to make permanent molds of these, but molds that would have a long life. The mold was a cast iron or steel frame. In it they set a compound, of which I do not know the composition, and they made this so they could get perhaps one to two hundred castings from it. The idea was it would last during the day's work; they would start another the next day and it would last through that day. It always struck me that this method offered a greater future than the permanent cast iron mold.

MR. REID: Ten years ago I myself made molds like this for

cylinders, 48 inches in diameter, and varying in length from 42 to 54 inches. We did not call the material a "compound." It was just a new mold. We cast right along about 18 castings, the average weight of the castings being 14 tons, out of each mold, casting two or three a day out of one mold.

THE PRESIDENT: I think Mr. Reid is a good man to work out this compound proposition. He has a good start.

THE SECRETARY: I have here a telegram which may interest some one. It is a request from the Beaver Dam Malleable Works for a first class core man. They regret their inability to attend, and wish us a successful meeting.

THE PRESIDENT: We want to keep our good men here.

THE SECRETARY: Certainly, but just the same there may be some good man wanting this opportunity. It also goes to show the value these conventions have to those who attend. I know many a case where a foundryman has met just the foreman he wants here, and could have a quiet talk with him. Many a good place has been thus filled, for there is always a good place for a good man, if the two can be brought together.

Further, our Vice President for New York also telegraphs us his best wishes for a successful meeting. He must be one of the few who are busy. Then our valued Foundry Lady member, Mrs. Clark-Fisher, whom we all know from last year's convention, wishes us all possible success, and asks us to shout for Taft. (Great applause.)

After some discussion on the appointment of a committee on the prevention of accidents in foundries (disposed of at the next session) the meeting adjourned.

AFTERNOON SESSION.

The President called the meeting to order at 2.45 P. M. The Secretary referred at some length to Mr. Porter's interesting method of getting together in manufacturing enterprises. Where harmony and efficiency was promoted by having the men in the

works represented at board meetings. Mr. Porter's further discussion will be found on another page. The president then called upon Mr. Long to read his paper on by-product coke making.

DISCUSSION ON BY-PRODUCT FOUNDRY COKE.

MR. WILSON: I would say that we are using by-product coke from the Salisbury plant in Detroit, and our specification for sulphur I believe calls for nothing above 0.7 or 0.75, and we get it below that figure and even running below 0.6. With the class of castings (we are making largely automobile work), where it is necessary to keep the combined carbon within very close limits in order to have a casting close grained, strong, and that will machine readily, it is absolutely necessary that we have a coke with no sulphur or with sulphur running within the limits we specify. I had one car of high sulphur coke sent me during the coal strike 5 or 6 years ago and this demonstrated to me clearly the trouble which I would have, and did have, with the sulphur running high.

THE PRESIDENT: Is your your cupola high or short between charging door and bottom?

MR. WILSON: I think it would be considered rather high.

MR. LONG: It is 24 feet, if I am not mistaken.

THE PRESIDENT: Does your coke stand that weight while burning, without crushing as well?

MR. WILSON: I cannot tell that because I have had so little experience with other coke. We have no trouble with the by-product coke.

THE PRESIDENT: Does the coke ring when struck, the same as the Beehive coke?

MR. LONG: It is a harder coke, but the grain is close. We started in to close up the grain to get rid of the waste in the car. I worked on that principle for 18 months before we put any on the market at all.

THE PRSEIDENT: I suppose the most important feature is the character of the coal you use.

MR. LONG: Yes sir. The coal is selected at the mines before

it is got up, and is put through a process of crushing. Sulphur determinations are made before the coal enters the oven, and our aim is low sulphur and high carbon.

MR. LASH: Why is it that by-product coke runs to slag more than beehive coke?

MR. LONG: That is something that is new to me. I never ran across it.

MR. SHERWIN (Chicago): We are at present running four cupolas, and we have all kinds of coke in the yard. I should judge we have about six cars between New River and the Seneca, but since adopting the by-product coke I must say the results are splendid. Now, whenever we run short of this coke I go to the foreman and tell him to use some other coke. Well, they scratch their heads and don't seem to care to use any other. This coke saves me time and less is used.

Mr. Harrington Emerson then read his paper on Needless Foundry Waste. (See page 77.)

DISCUSSION ON NEEDLESS FOUNDRY WASTE.

THE PRESIDENT: I am sure Mr. Emerson will be glad to have his paper discussed. If anyone would care to suggest anything to amplify or add to it we shall be glad to hear from him. I might say I was quite impressed by Mr. Emerson's statement as to the enlarged earnings made by adopting his system, which I imagine is the premium system or some modification of it. I should like to ask Mr. Emerson if the personnel of the shop was changed to any great extent to produce that result.

MR. EMERSON: No. The same equipment, the same men, the same foremen, the same management throughout. Now, the reason that the product increased so much is because there is an increased output. That is one of the reasons, and then there is decreased cost. If you have a standard cost of say $1.50 for a certain item and are selling it at $1.60, there is 10 cents profit, if you can reduce the cost to $1.25 and still sell it for $1.60, there is 35 cents profit, instead of 10 cents, and if you are making 50 per cent more pieces, instead of having 35 cents, why, you would have about 50 cents, so that you would make 50 cents where for-

merly you had made only 10 cents. Now, with reference to the man. The man may have been earning say $60 a month. There is very little over of $60 a month if he has a family. He may be able to put aside $3 or $4, but if he has to call the doctor in his little savings are gone. If he is laid off on account of sickness, his savings are soon swept away, and he feels bitter and hostile, he feels that he is not getting a fair share out of the matter. Naturally he is willing to antagonize the employer. The employer on the other hand knows the man is not giving a full return for the wages he is receiving, he feels very often that here is the chance to cut him, to reduce him down to $50 instead of $60. Now, if that man can earn $75 instead of $60 and at the same time reduce the cost to the employer, instead of saving $2 or $3 a month he is saving so much more that his net profits have gone up 2 to 3 hundred percent, just as they would on the profit to the employer.

THE PRESIDENT: Would you place the increased depreciation on your books, or would you consider the depreciation constant under both systems?

MR. EMERSON: Increased depreciation on your plant? Why?

THE PRESIDENT: I would think you would have increased wear and tear. You are working your tools under very high pressure, or else very low pressure in the first place.

MR. EMERSON: Both are generally true.

THE PRESIDENT: Do you not wear out your machine tools faster?

MR. EMERSON: Not necessarily, because under this system every detail is looked after in the most careful manner, and the efficiency and condition of the tools kept up.

THE SECRETARY: Mr. President, and gentlemen:—Mr. Falconer, the chairman of our Committee on Costs is unable to be present, but I have his report here and being a member of the committee myself, will read it, with your permission.

REPORT OF COST COMMITTEE.

At the Philadelphia Convention of this Association, May, 1907, the Committee on Costs as then constituted was continued for

another year, and instructed to report at the next convention of the Association.

The Jobbing Founder's Association having appointed a committee to work along similar lines, it was deemed advisable that the Committees of the two Associations should work together.

During the past year several joint meetings of these Committees were held, Mr. J. S. Sterling, Secretary of the Jobbing Founder's Association, with several of their members discussing cost matters with the A. F. A. Committee which consisted of Messrs. Harrington, Emerson, E. M. Taylor, R. Moldenke, and Kenneth Falconer, Chairman.

Under date of Nov. 27th, 1907, Mr. Stirling submitted to his Association a report on "Uniform Cost Methods" for Jobbing Foundries, which we understand has been approved, and largely aaopted by members of that Association.

Your Committee recognizes that it is impossible to lay down hard and fast rules regarding details in figuring costs, making estimates, and basing tenders, but at the same time feels that the best interests of the Foundry Business demands some degree of uniformity in the basic principles on which costs are figured. With this idea in mind the preparation of a Chart outlining the main divisions of costs was delegated to Mr. Harrington Emerson, and the Chart as prepared by him is attached hereto.

Your Committee desires it to be understood that they only endorse this Chart for general use so far as main divisions are concerned; details to be arranged in each case according to the requirements of individual plants.

The final decision of the two Committees was that to secure the best possible results certain clear-cut lines should be drawn, defining cost of product up to and including certain processes; but that further analysis of such costs should in each instance be left to the individual judgment of the Plants.

In view of the fact that in the majority of cases it is commercially impracticable to obtain record of the cost of individual castings, the accompanying Chart was designed with the idea of dividing the foundry output into classes, the number of which would depend upon conditions and circumstances; in the Chart

attached, the output is divided by Mr. Emerson into approximately ten classes.

The actual cost of foundry output has been divided, as will be seen by reference to the Chart, into the following main divisions:

1. Metal.
2. Labor.
3. Indirect Expenses chargeable on basis of weight of output.
4. Indirect expenses chargeable as percentage of direct labor.

If those competing in the foundry business for orders would base their figures on some such classification, sub-divided to such detail as may be found advisable in individual cases, the result would be a benefit to the entire trade and would tend to eliminate the reckless competition to which is largely responsible the present unsatisfactory condition of the foundry business.

Respectfully submitted,

KENNETH FALCONER, Chairman.

The Secretary: The Committee presents this report, and Mr. Ellsworth Taylor, also a member of the Committee will go into the matter more fully in giving his paper on the Development of a Cost System for the Foundry.

Mr. Taylor then read his paper (see page 37 and also 65).

The Report of the Cost Committee was adopted.

DISCUSSION ON FOUNDRY COSTS.

The Chairman: There must be a great many questions which naturally arise in your mind in following Mr. Taylor through an exhaustive paper, and I shall be glad if you will raise some of those questions. With your permission I will ask one question. On page 40 of the summary of cost, item 4, I noticed under sub-division (a), cost of items to be distributed as sur-charges or burden on metal distributed on basis of weight of good cast-

ings; and (b) Cost of items to be distributed as sur-charges or burden on basis of per cent of applied or direct labor. Would you mind explaining why you use pound basis in one instance and per cent in the other?

Mr. Taylor: The Committee decided that for every pound of iron as it went along from the time it was put into the cupola till it came into the form of a casting, certain material purchases and supplies were eaten up relatively in accordance with the weight of the casting; that there were other items which were eaten up or used up in the cost of the casting in accordance with the length of time the casting was in operation, and not in accordance with its weight.

Mr. Field (Pittsburg): I spent about an hour reading Mr. Taylor's paper yesterday, and I think the Association should consider themselves very highly complimented in receiving a paper which has taken the work that this has required. I have read all the costs papers brought up during the last two or three years, and I have never seen one so complete, and which the smallest foundry as well as the largest might follow. I think we are all indebted to Mr. Taylor for the amount of work it has taken to prepare this paper. (Applause.)

The President: We will now have the report of the Committee on Industrial Education. Mr. Kreuzpointner's report is in print, hence he will address only a few additional remarks to you in further elucidation of the subject.

REPORT OF THE COMMITTEE ON INDUSTRIAL EDUCATION.

Your committee on industrial education takes pleasure in reporting an increasing interest, in all parts of the United States

and Canada, in the discussion of the problem of how to educate the millions of industrial workers to that degree of mechanical skill and intellectual efficiency which is necessary to maintain national welfare and progress in civilization.

During the last week of January your chairman attended the annual meeting, at Chicago, of the National Society for the Promotion of Industrial Education, where some forty speakers, selected from among manufacturers, educators, professional men, labor leaders and philanthropists, presented reasons why it is necessary to create a system of industrial schools. There was no question of the unanimous conviction among the large gathering of professional and practical men that something must be done along lines of industrial education at any cost. .

But as to the ways and means by which such a system of schools is to be established there was an endless variety of opinions and nothing definite offered to help towards the speedy solution of the problem. Your chairman was honored with the request to explain to the meeting the workings of the German Continuation and Trade Schools.

Early in the year the attention of your committee was called to a bill before Congress, introduced by the Hon. Charles R. Davis, of Minnesota, the purport of which was the raising of a per capita tax of ten cents to establish and maintain industrial and agricultural high schools, one-half of the proceeds to be appropriated for industrial high schools in the cities and one-half for agricultural high schools in the rural districts. Reference to the bill was made in a recent issue of our Transactions. Your chairman considered it in the interest of the American Foundrymen's Association to support the bill and asked our officers to write to their Representatives in Washington in support of the bill. Recently your chairman had the honor to appear before the State Educational Commission of Pennsylvania, a commission created by the Legislature to revise the school laws and school procedure of Pennsylvania. He was assigned the pleasant duty to impress upon the attention of the Commission the necessity of school play grounds and a state school architect. The problem of industrial education also received

a good deal of attention by the Commission and your chairman was likewise permitted to give his views upon that subject.

Your Committee sent out 500 copies of last year's address to the Foundrymen, as published in the November Transactions. Most of these were sent to professional educators with the object of calling their attention to the educational needs of our industries. The acknowledgements received unanimously express the fullest approval of the ideas advanced in that address, difference of opinion referring only to slight minor details. Thus is won the confidence of the school people without whose help the industries cannot solve the problem of industrial education.

Your chairman also wrote to a number of educators all over the country asking for their advice and co-operation, and offering the co-operation of the American Foundrymen's Association in return. A number of very courteous replies and valuable suggestions have been received for the guidance of your committee.

It appears that the National Association of Builders Exchanges has also a committee on industrial education in the field, and in answer to a letter, received from the secretary of that Committee asking for advice and help in their work along the same lines your committee is engaged in, the desired information was given and promises made to continue the correspondence.

Your Committee therefore reports progress.

The voluminous discussions at the Chicago meeting of the National Society for the Promotion of Industrial Education, the proceedings of other societies as far as they relate to this problem, the extensive correspondence of the chairman of your committee, while universally admitting the urgent necessity for the establishment of industrial schools of one form or another, give no practical, tangible and definite suggestions as to the methods of raising the revenue to establish and support a system of industrial schools or trade schools; how teachers are to be obtained for these schools, where the training schools for the teachers are to be found, how we are to get the millions of boys and girls into the industrial or trade schools, even though the money for their establishment and maintenance has been

forthcoming; how to keep the boys and girls of 13 and 14 from rushing into shop, store and factory to earn a pittance for spending money when the standard of living is so high that common sense frugality is considered a badge of poverty punishable by exclusion from society. Nor have we ever heard of any suggestions made in convention or out of it how we are to prepare those millions of wage workers who are destined to carry on the minor parts of our modern industrial activity, the results of which form, in the aggregate, an important link in the successful management of a modern establishment, as well as the material welfare of our national industrial fabric.

Nor yet have any suggestions been forthcoming thus far, how we are to prepare the millions of industrial workers, skilled and unskilled, for the complex duties and responsibilities of life under the changed social and economic conditions from what these conditions were even twenty years ago. Any scheme of industrial education for any specific class of industries, or the nation as a whole, will remain one-sided and inadequate if it does not take this into consideration.

The higher skilled mechanic acquires with his education a certain degree of culture, and the variety of mental activities, set free by this education, enables him to adjust himself to the cultural requirements of his environment; the semi-skilled or unskilled industrial worker does not acquire this mental power, or if he has acquired it, it is in danger to be largely lost through the unavoidable specialization of modern methods of production. His education must, therefore, be supplemented even more carefully by a civic-ethical education as a foundation whereupon the peace and welfare may rest secure among the majority of our industrial workers.

Think of the consequences to society of training millions of mechanics by a system where the older "kid" or the "kid" above is the teacher of the younger "kid" or the "kid" below, with no allusion to the moral sense of duty, or responsibilities to society, no conception of the relation of his work to the work of his neighbor or to the welfare of the community. A barbarian may be a very ingenious man, but he remains a barbarian for all

that. To insure the peace, and harmony and welfare of society and to preserve our civilization, we need something else in our industrial education than an education which trains for increased productive capacity only, and nothing else. Nor can we meet the much talked of foreign competition with any one-sided productive training when our competitors look to the cultural training of their mechanics as well as to their skill. An education which trains the individual to take all advantages out of the social soil without at the same time training the individual to enable him, or make him desire, to put something back into the social soil as a fertilizer, as it were, such a training will defeat itself in the long run and become a menace to our institutions and to society.

If you ask what assets we have in our educational system to meet the industrial requirements, the answer is that our assets are rather poor to start business with. The manual training high schools and the few endowed trade schools train their pupils away from the shops, and therefore do not reach the great mass of those who are to make their living as practical mechanics and helpers. In quite a number of high schools manual training has been introduced, but it confines itself chiefly to woodwork because of lack of funds for a more expensive equipment and lack of room. What little there is done goes but a little ways because the work done is along lines of mechanical dexterity chiefly and the drawing and academic part of the instruction is cramped for time, being obliged to go along with the classical course, the scientific course, and perhaps some other course. Moreover, the boy who goes to high school rarely cares to go into the shop as an ordinary mechanic. This leaves us with manual training in the common school as the really practical available asset to begin a system of industrial education with. If this manual training is made more technical and reorganized otherwise to meet the needs of the industries and changed social conditions, it will serve excellently as a preparatory course for specific trade education, or as a general industrial course where there are no trade schools or where specific trade education is not wanted. Such a broadened and deepened manual training course would go a long ways to reach that great number of boys and girls who do not wish, or cannot spend the time for

learning a trade. This manual training course could be so arranged that it would cover the two years from leaving the grammar school to entering a definite vocation without interfering with the high school. It the States would subsidize manual training, it would go a great ways to make this asset a very valuable one. For specific trade training in a given industry, say the foundry, the industry together with perhaps other industries might join in petition to the school authorities for the establishment of a trade school. Trade schools are expensive and even if we had the money to establish trade schools, we would have no trained teachers to take charge of the schools. It is difficult enough to get good manual training teachers.

However, even after we have the schools and teachers and a good organization and plenty of money to go ahead with our plans, we would still have the problem how to induce the boys to spend time in our proposed manual training and trade schools. Here the industries must step in and aid the schools by recognizing the value of such a preparatory course by increased wages for the boy who enters the shop from such a school, or lower the pay of boys entering the shops who have not had such a schooling.

The boy or girl who, leaving the grammar school and going to work immediately, without having entered the, what we might call, preparatory industrial course from 14 to 16 years, but has been benefited by the beginning of the course in the grammar grade, is worth more than the child leaving school at 12 or 13. On the other hand, the boy having taken this two years preparatory industrial course should have such a general mechanical and technical knowledge and manual skill, as to easily adjust himself to the special knowledge required in that particular vocation. Here also the trade schools would find their sphere of usefulness by enlarging one's knowledge in the evening trade school in conjunction with the practical shop work during the day. The two years preparatory course should be taught in separate schools, as a continuation of the common school system, and not in connection with the high school. This would relieve the high school without hindering it to have a higher industrial course and its usual scientific course all in one, thus giving an outlet for those who want something higher than what is ob-

tainable in the preparatory course or in the trade school.

Such an arrangement would solve the vexed question of what to do with the two years after leaving grammar school, which are now unproductive from the educational standpoint, it would relieve the high school and prevent that mental dissatisfaction and reluctance to go back to the shop from the high school, and finally it would allow the development of trade schools in a natural way according to the natural necessities of an industry or group of industries. But the industries must actively and effectively help themselves and the school people by recognizing the value of such a training by the adjustment of wages paid to boys, girls and journeymen, according to the degree of preparation with which the young people enter their employment.

If the Foundry industry, or any other industry, can see its way clear for the establishment of local trade schools for boys leaving the grammar school, then all the better. But the difficulty with us in this country is that the 14 year old boy is not wanted in the shop and the boy does not know what he wants.

But since we as a nation, for economic and ethical reasons, can no longer afford to have two precious years of millions of our young people practically wasted educationally, we owe it to ourselves and to our country to remedy that defect, and the proposed two years manual training course as a continuation of the common school, would seem to offer a way out, if the industries regulate their pay according to value received from the school. Such a fundamental arrangement would not bring an undesirable strain upon the organization of our educational system and at the same time offer a maximum of flexibility to meet local conditions. If the last two years can be recovered by compulsory attendance, all the better.

Summarizing the conclusions of your committee, the following propositions are respectfully submitted for the consideration of the members of the American Foundrymen's Association:

1. Industrial education and trade training, the former to develop that intelligence and skill of hand necessary to grasp the relations of human activities and the latter as a preparation for the specific work at a trade in a shop, having become vital issues in the life of our industries and the whole social fabric, the harmonious and united action of all social forces is needed to estab-

lish such a system of schools and efficient, well paid teachers, as will secure for our industries the needed skill and intelligence.

2. Constant agitation by the members of not only one industry, but of all industries and business interests is required to convince the people of the necessity of furnishing the means to establish such schools and enlarge our system of education.

3. That such a system of industrial education must include not only the skilled mechanics or particular industries, but all industrial workers of any kind, skilled or unskilled, male or female.

4. That this industrial education and trade training must not only consider the mechanical and technical necessities of the mechanic, but also the culture and moral æsthetic side of life of the man and citizen.

5. That manual training, as now conducted, is too exclusively devoted to the acquisition of manual dexterity, but if broadened and deepened and made more technical by the addition of suitable subjects, it can be made an excellent foundation for industrial education and become a preparation for trade training. Thus, if added as separate courses to the common school system, manual training could be made to serve to bridge the educational gap from 14 to 16 years of age which are now lost years. On account of that gap, due to the indecision of the boy regarding the occupation he will follow, a system of specific trade schools, in our country, becomes feasible and worthy of the expense, as an additional training only for those who are already actively engaged in their chosen vocations.

6. The burden of conducting these industrial schools should be equally divided between the community and the State.

7. To adjust the wage scale for boys and girls in shops in conformity with the standing and practical attainments acquired in the industrial schools.

8. It is considered desirable for all industries to agree upon a plan whereby an approximately uniform standard of efficiency of school attainment be required of boys and girls seeking employment in industrial establishments.

9. That the Foundrymen devise some system of imparting information on shop practice among their force, either through their superintendents or foremen, for the general good of the

industry. This more particularly in view of the rapidly diminishing resources of the country.

Respectfully submitted,

P. KREUZPOINTNER, *Chairman.*

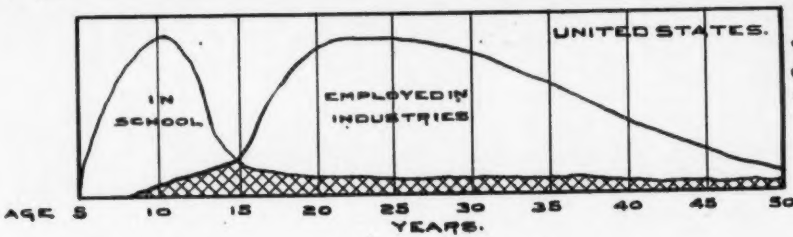
MR. KREUTZPOINTNER: Mr. President and Gentlemen:—This question of industrial education is rapidly assuming not only national, but international proportions, since every industrial country, at present, is straining every nerve to educate the industrial workers up to the highest point of efficiency. Knowledge, judgment and discriminating intelligence not only on the part of the manager, but also on the part of the industrial worker are, and will be, absolutely necessary for the preservation and extension of the industrial system and social wellfare of every industrial country.

In view of the diminishing of our resources, in quantity or quality, or both, and the enormous quantities needed, the utmost economy in the mining of raw materials, the cost of mining, the cost of supplies and labor and everything pertaining to production must be practiced and the technical knowledge acquired in order to be able to achieve economic results. And to this end the intellectual resources of our young people must be developed to the same extent that we have developed our material resources.

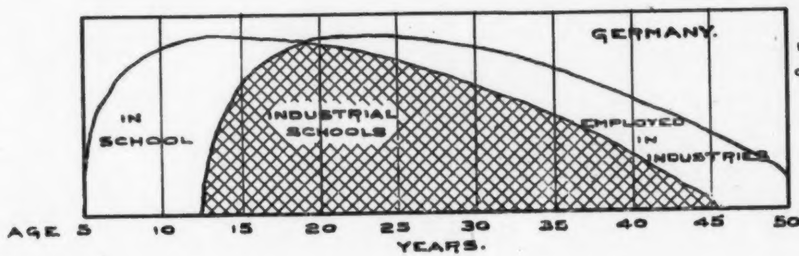
Allow me to ask you in all sincerity, how can we retain our industrial and commercial supremacy and maintain the high moral and intellectual standard of the people, necessary to industrial integrity and progress, in competition with other countries, if we are as backward as is shown by this chart, prepared by Prof. C. T. Warner, Principal of the Technical High School, Springfield, Mass.

Our school population is indicated by the line rising rapidly from 5 years of age and dropping as suddenly at 13 years of age. While at 10 years of age there are still 89 per cent out of every 100 children in school, at 14 years only 67 and at 15 years only 50 out of every 100 children are found in some kind of school. In 1906 there were at work between 10 and 15 years of age

DIAGRAM DESIGNED BY PROF. C.F. WARNER, SPRINGFIELD MASS.



SHADED PORTION.
CORRESPONDENCE,
EVENING AND
Y. M. C. A. SCHOOLS.



SHADED PORTION.
INDUSTRIAL AND
CONTINUATION SCHOOLS.

688,207 children in other than agricultural pursuits and what little preparation for the actual struggle for life our young people get is indicated by the shaded area comprising all the manual training, evening schools, correspondence schools and Young Men's Christian Association classes.

All the great mass of industrial workers, indicated by the blank area did not receive and does not receive any preparation at all for the intelligent fullfilment of their duties as parents, as citizens, as employees and mechanics, except what they have learned incidentally in the often too short and often too superficial instruction in the elementary schools, or otherwise, through general education. Moreover, we are at a great disadvantage in having absolutely nothing to offer in the line of useful, practical education to young people, from leaving the school to 16 years of age unless going to the high school and only five out of every 100 do that. The two years from 14 to 16 years of age, as pointed out in my report, are the critical years where the mind is receptive for the more serious work of life but, as indicated by the gap in the diagram, we have nothing in our educational system to fill this gap, and the young people rush into factories, stores and offices and forget what little they have learned. I know from personal experience in teaching apprentices, messenger boys and journeymen, how difficult it is to revive mental activity once a boy or girl has dropped school work. Now look at the diagram illustrating German industrial education. The first line includes the area of common school and industrial school attendance and the second line includes the area of attendance, by the industrial population, of industrial, that is trade, and continuation schools, indicated by the shaded area. You notice there is no gap, no dropping out wholesale, as with us, and practically the whole population goes to school, of one kind or another, until about twenty years of age.

Out of the common school and into the trade or continuation school until 17 or 18 years of age is the law and it is compulsion of the most severe kind. Of late they are abandoning the old time practice of having these industrial schools on Sunday, except for girls, and the masters and business men are compelled to send their apprentices or clerks to school during working hours for six or nine hours a week.

Having visited several schools in Toronto I find that our Canadian friends are ahead of us, since the schools here in Toronto have the two years continuation course from 14 to 16 years of age advocated in the report of your committee. That is, they have what we might call a ninth and tenth grade, so that children, not going to the high school, can go to school until 16 years of age or until they enter vocational life, thus filling that distressing gap which we have in our educational system in the United States. Tuesday I visited one of Toronto's public schools and in the ninth or continuation grade of that school the principal dictated to the commercial class portions of the report of your committee, to be taken down in shorthand and then to be read aloud from these shorthand notes, to be criticized, or corrected by me. One of the girls wrote out her notes upon the typewriter and I have that example of the able and energetic work of the schools of Toronto now in my pocket. (Applause.) During the year your committee on Industrial Education has carried on the work along National lines, rather than in the interest of one individual industry, because of the interdependence of all the industrial interests throughout the country and the necessity of organized effort in order to accomplish something permanent. (Continued applause.)

The Secretary: Mr. President and Gentlemen:—In the report of the Committee on Industrial Education, which you will also read in the Transactions, (Mr. Kreuzpointner being chairman, and incidentally the only member so far appointed), you will find all the work done during the year fully described. Mr. Kreuzpointner has brought the name of the Association very prominently before the educational bodies of the country. He is consequently known everywhere. Why even in Toronto here, they were good enough to call the children out to give a fire drill in honor of the American Foundrymen's Association and its representative, Mr. Kreuzpointner.

Mr. Kreuzpointner has prepared a resolution, which with the Chair's permission, I will now present.

Whereas, there is urgent need for unreserved co-operation of all citizens, of whatever profession, vocation, or station in life, for the purpose of meeting the educational wants of our industries and commerce, therefore be it

Resolved, that the members of the American Foundrymen's Association, in convention assembled in Toronto, note with great satisfaction the increasing manifestations of interest in the United States and Canada, by the schools and teachers, in the important subject of industrial education, and their earnest effort to solve the problem of how best to adapt the school to new conditions of life. And be it further

Resolved, that the Committee on Industrial Education, of the American Foundrymen's Association, be hereby authorized to transmit copies of these resolutions to the various teachers' organizations of the United States and Canada, and to express to them the thanks and appreciation of the American Foundrymen's Association, for the efforts of the teachers in behalf of our youth, and to express the desire of the members, for the teachers to continue their interest and to communicate freely with the Committee.

Resolutions were seconded and adopted unanimously.

Mr. Kreuzpointner (in the temporary absence of Prof. Johnson, of Winona Institute, who had the next paper) gave a brief talk on Industrial Education in the middle ages. See further on in the Transactions.

Prof. Johnson then gave a lecture on the Winona Institute, illustrated by lantern slides. Also distributed copies of the Handbook of the School, stating that any one who desired this could have it by writing to the Winona Institute, Indianapolis, Ind. (See page 95.)

Dr. Richard Moldenke, then gave an illustrated talk on coke making for foundry purposes, in the United States. In going through the United States in the interest of the Government for a Report on the subject, he had taken a series of Photographs, from Pennsylvania to New Mexico. Many of these had been prepared as lantern slides, and were for the first time shown here. When the report is completed, it is hoped that enough copies will be available to send to the members of the Association.

The Convention then adjourned to the next morning.

TROLLEY RIDE TO SCARBORO BEACH.

On the evening of the second Convention day, a trolley ride was tendered the convention to Scarboro Beach, the Coney Island

of Toronto. From the frozen but happy faces of those who returned later in the evening, the affair must must have been a success, though the Secretary cannot give further details, as he utilized the evening at the Registration booth, to catch up with necessary correspondence and preparations for the coming meetings. Incidentally it may be of interest to those who watch how smooth the conventions run, that the work of preparation is so heavy for both the Secretary of the Supply Association, and of the American Foundrymen's Association, that the latter had to write his paper on Titanium in Cast Iron on the train going out to the convention a week before it took place.

ENTERTAINMENT OF THE LADIES.

The one hundred and forty ladies who graced the occasion with their presence were royally entertained by the good Toronto Committee. Mr. Anthes and Mr. Somerville looked after the general arrangements, while the Misses Anthes piloted the visiting ladies about the interesting points of the city. To Mr. Ingalls, the everfaithful, the Ladies will look back with especial gratitude as he neither ate nor slept during the whole convention, in order to be of every assistance to his fair charges.

The excursions to the shops and stores, to the convention exhibits, the Moonlight Excursion, particularly the high compliment of the Yacht Club in placing the Launches at the disposal of the committee, and tendering a luncheon to the party on the Island. A grand automobile ride, and finally as a fitting climax, the Theatre party, while the men were at the smoker. The universal verdict was a request to the respective "hubbies" to have the convention at Toronto next year again. When that time comes again the Ladies registration will be fourteen hundred.

CLOSING SESSION, FRIDAY, JUNE 12TH.

The President called the meeting to order at 10.40 a. m.

DR. MOLDENKE: I have here a letter from Professor Thomas Turner, the famous English Metallurgist. He sends greetings and regrets that he cannot be here. Then we have an invitation

from the Lackawanna Steel Company. Several gentlemen want to see the furnace at Buffalo, and we suggest that they leave here tomorrow by the 9 o'clock train.

Then there is a resolution here by Mr. West, which came up yesterday, and action was deferred.

Mr. West desires, if the Association sees fit, that a committee be appointed by the Association to take up the question of prevention of accidents at foundries.

MR. KREUTZPOINTNER: I second that.

THE PRESIDENT: The motion put by the doctor for Mr. West is that we shall appoint a Committee to look into this matter. The Committee I suppose, to be appointed by the Chairman. Mr. West will be the Chairman, and he will select his own Committee. (The resolution was carried.)

MR. KREUTZPOINTNER: I beg to offer the following that this Association request its incoming Board to carefully consider the question of allowing its President and Secretary a proper amount to defray their expenses necessary when attending this Convention. (Motion is duly seconded.)

MR. WEST: Allow me to say in favor of the motion that it is not more than just to allow the payment of expenses to the officers, especially to the Secretary and President, inasmuch as it is customary with all large corporations, when they send their employees to this convention to pay their expenses. Why should not an Association like this reimburse its Secretary and President their expenses? There is a great deal of labor, bother and loss of time connected with the arrangement of the Convention, and in justice to the members of this Association it is desirable that they should consider this matter in a favorable light. (Carried).

THE PRESIDENT: Mr. Field will now offer some resolutions. He has several concealed about his person.

MR. FIELD: I have a resolution here which I would like to offer:

"Resolved, that whereas the larger work naturally devolving upon the Association will require a greater income, and whereas the income should naturally come from its yearly dues: Resolved that it is the sense of this Convention that there be a referendum vote of the entire membership to decide the question of increasing the dues from $5 to $10, and that a two-thirds majority of the

total membership vote shall be necessary to pass it." (Motion seconded.)

THE CHAIRMAN: The motion is now before you. Any discussion? If you notice, the resolution does not settle the matter now. It simply shows it has been discussed in open meeting, and it will require a two-thirds majority to pass it. (The resolution was carried unanimously.)

MR. FIELD: I have a question on the specifications of foundry iron, which the doctor has just asked me to look over. My personal opinion differs from the doctor's a little. I think it would be very much better if we put this again in the hands of a Committee so that the thing may be threshed out this year. I believe the Cincinnati Foundrymen have adopted a set of specifications, which, if they could put through all over the country would relieve foundrymen of a whole lot of trouble. One of the provisions of it, as I remember, is, if the furnace man does not supply you with iron as it becomes due, you can go out in the open market and purchase, and charge it up to him. As far as I understand, some of the furnace men in that neighborhood have practically agreed to this. I do not think Cincinnati should be favored in that way. I think it would pay to appoint a Committee who might investigate this matter and take it up. I move that a committee of three be appointed to take the matter of specifications up and report at the next Convention.

THE PRESIDENT: Would you like some lawyers on that committee?

MR. FIELD: As long as you are spending money for officers' expenses, you can afford $10,000 to hire a good big lawyer. I will include that in the motion. (Laughter.)

DR. MOLDENKE: Why I have asked Mr. Field to bring this up, is that the American Society of Testing Material is going to meet in two weeks time in Atlantic City, and they would like to hear how we feel on the subject. What Mr. Field brings up is new and interesting. We were not thinking of the business end so much as the technical end. The changes in the specifications so far suggested are merely changing from grade numbers to analysis completely. If we could have a resolution of the Foundrymen in favor of changing from grade to direct chemical specifications first it would have some weight on the action of the society.

THE PRESIDENT: Mr. Field, will you withhold your motion temporarily to give the doctor time to frame one as just stated?

MR. FIELD: Yes.

DR. MOLDENKE: It is merely to get the sense of the Association if in favor of chemical analysis as against grade numbers. I make the motion that this Association advocate a change in the specifications so that pig iron sells by chemical analysis entirely, and not by grade number.

Seconded.

MR. FIELD: I was going to propose an amendment that the American Society of Testing Material appoint a committee to provide for this in conjunction with the different American Associations, to see that the specifications are enforced.

THE PRESIDENT: Your motion would be rather involved to tie that up with this. You might say that this Committee be instructed to meet with the Testing Materials Committee.

MR. FIELD: That will be all right.

THE CHAIRMAN: That we recommend the substitution of chemical analysis for the grading numbers as used in selling pig iron. (Seconded and carried.)

MR. FIELD: I move now that the Association request the American Society of Testing Material to appoint a Committee to get out a set of specifications which shall be of some value.

DR. MOLDENKE: I will second that with pleasure. You see the American Society of Testing Material has a committee which is in existence for this purpose, and they want to change those specifications along the lines explained, but are just waiting for our endorsement. I know our Association is in favor of this, but we had this thing to run up against that the furnace men in the American Society of Testing Material are not specially anxious for the change. We want the weight of this Association to bring about prompt action. I think Mr. Field's object would be attained if the present general committee on Cast Iron were requested to take it up with our Association.

MR. FIELD: I have the same thing in mind about the Materials Committee. It is absolutely impossible to get anything through, that is anything reasonable. I went to one meeting just for that one thing, and spent about an hour at it, and they just

simply laughed at me, and said "That is a very good thing, but you cannot get it through this Committee."

DR. MOLDENKE: When we had our little meeting last October the whole Committee on Cast Iron brought this thing up, but the sub-Committee on Pig Iron did not seem to want it. However, the whole Committee will decide this matter, and you will find they will be ready to do what we foundrymen want.

THE PRESIDENT: I think the doctor and Mr. Field had better get out in the open and settle this. (Laughter.)

DR. MOLDENKE: No. I am in favor of Mr. Field's motion, but you cannot ask the American Society of Testing Material to appoint a new committee when they have one already existing.

THE PRESIDENT: Let me hear the motion again.

MR. FIELD: I move that the American Society of Testing Material be requested to appoint a Committee, or if they want, designate the old Committee, to confer with the committees of the different Foundry Associations interested in the subject to take up the matter of specifications for buying foundry pig iron. (Seconded and carried.)

MR. FIELD: Mr. Chairman, I move that a vote of thanks be extended to the Civic authorities in Toronto, to the Canadian Manufacturers' Association, to the Canadian Reception Committee, the Toronto Reception Committee, and to the Ladies Committee, especially to Mrs. and Miss Anthes, who have been so kind in entertaining the Pittsburg—(Laughter)—I mean the American Association. I want it to be said from the standpoint of the Foundrymen that we certainly have appreciated what these committees have done for us, and I move, Mr. Chairman, that this resolution be submitted by the Secretary to the various persons mentioned in the resolution.

MR. ANTHES: Possibly as a representative of the various committees referred to, I may be permitted to just make a few remarks. It has only been a pleasure, I think, to everybody, to greet the American Foundrymen's Association and allied bodies in convention here. I do not know of anyone who has had any fault to find, both on the part of the guests and on the part of the entertainers, everybody has been more than happy. The Executive of the Canadian Manufacturers Association, of which I am a member, have expressed to me the fact that they never

have had as fine a gathering of men in any convention in Toronto before, that everybody has appreciated the fact, not only of the American Association coming and holding the convention here, but also the fact that they and the Supply Association, and the other bodies have been very liberal in the way they have exhibited, and also upon the demonstration of the various molding machines and other foundry equipment. It has been an education for the Canadian, and has been greatly appreciated. Everybody who has had anything to say to me has nothing but congratulations to offer the Association. (Applause.) Mr. Thompson, the Commissioner of Industry, and Mayor Oliver have both extended to me their thanks—I do not know why they should thank me particularly—in getting such a fine body of men to visit Toronto. We hope some day to see you again, and you will be received with open arms. (Applause.) (Motion carried unanimously.)

Mr. Field: I move that this Association pass a vote of thanks to all those who have so carefully and willingly prepared papers and discussions for this Association, also to the Supply Association for the many courtesies which they have extended in making arrangements for these meetings. I think we all appreciate the manner in which the details have been taken care of through their secretary, Mr. Lane. (Seconded and carried.)

Mr. Field: I move a vote of thanks to the officers and Committee who have acted so finely for us during the past year, making special mention of the Industrial Education and the Cost Committee, especially in relation to the latter. I do not think we can thank them too much for the great amount of time and exertion which they have spent in getting out these standard costs for the American Foundrymen's Association. I make the motion that a written vote of thanks be extended to them by the Secretary. (Seconded and Carried.)

Dr. Moldenke: Here is another Resolution.

"The American Foundrymen's Association feel deeply grateful and appreciative for the evidently heartful courtesies and cordiality extended by the school authorities to the visiting foundrymen who took the pleasure to acquaint themselves with the educational system of the city of Toronto.

Especially does the American Foundrymen's Association de-

sire to express sincere thanks to Mr. James L. Hughes, Chief Inspector of Schools, Professor Alfred H. Leake, Inspector of Technical Education, Province of Ontario; the members and teachers of the Technical High School, of the Normal School, the Queen Alexandria Public School, the Wellesley St. Public School, and the Jarvis St. High School. The conduct of the pupils, their pleasant politeness towards the visiting foundrymen, and the tidiness and general appearance of the schools speak highly for their evident successful management."

Mr. Kreuzpointner supported the resolution which was carried unanimously.

Mr. Field: Once more, and this is a very pleasant duty this time. Gentlemen, I have to move that a certain member of this organization be made an honorary member of the American Foundrymen's Association. This is a double pleasure. I am sure you will vote for this on account of the very able way in which the affairs of the Association have been conducted by our President during the past year. The careful attention to detail, and his dignified presence as the presiding officer have been such I am sure as to make you all very pleased to vote for this motion. I therefore move that our retiring President, Mr. Stanley G. Flagg, Jr., be made an honorary member of the American Foundrymen's Association. Seconded and Carried unanimously.

The President: I am very much obliged to Mr. Field for his thoughtfulness, and to those present for according to me this honor.

The President: The next duty is to hear from the Nominating Committee, of which Mr. Field is Chairman.

Mr. Field: Mr. President and Gentlemen:—Your Nominating Committee beg leave to present the following officers for the coming year:

For President, Mr. L. L. Anthes, The Toronto Foundry Company. Vice-Presidents, F. B. Farnsworth, McLagon Foundry Co., New Haven, Conn. Wm. H. Parry, Nat'l Meter Co., Brooklyn, N. Y. J. W. Jeffry, Ohio Malleable Co., Columbus, Ohio. Samuel T. Johnson, Chicago, Ill. J. W. Sheriff, Sheriff Mfg. Co., Milwaukee, Wis. J. W. Kissick, Columbus Iron Works, Columbus, Ga. R. J. Cluff, King Radiator Co., Toronto, Ont.,

and some members of the Pittsburg Association have insisted that your humble servant shall also be a Vice-President.

Duly moved that the report of the Committee be accepted. Seconded and carried.

A MEMBER: I move that the Secretary cast a ballot for the Association. Carried.

The Secretary accordingly cast a ballot.

MR. FIELD: I have also pleasure, as Chairman of your Nominating Committee, to present again for Secretary and Treasurer the very able and efficient present Secretary, Dr. Richard Moldenke. While we had very considerable discussion as to who should be Vice-President, there was only one mentioned for Secretary and Treasurer. I therefore move that a rising vote be taken. Seconded and carried by acclamation.

DR. MOLDENKE: I can only say like every other time I will try to do better next year. (Applause.)

The retiring President at this point conducted Mr. Anthes to the Chair.

MR. ANTHES: (Received with applause.) Fellowmembers of the American Foundrymen's Association:—This is one of the times in a man's career when he is wrought up to such a pitch that he seems to strike against a hard wall when he wishes to express himself. I can only say that my gratitude to the members of the Foundrymen's Association is such that the English language is not adequate enough to express it. I have received nothing but the kindest treatment ever since I became a member of the Association, when first taken in hand by our most esteemed Secretary, Dr. Richard Moldenke, who took me a very young, crude foundryman and pointed out to me the higher lights in the foundryman's vocation. Since then I have been an earnest student in foundry work. I have found and appreciate the fact that the foundry business is no longer a mere labor with the object of attaining monopolistic ends but it has resolved itself into a science, a science such that the most enlightened men of the age are taking a big interest in it. There is no limitation in the foundry business. It affects every mineral we have and brings into action practically every natural and physical law. This can be borne out by the demonstrations we have had before us at the annual exhibition of the Foundry Supply Association. Ideas

and principles which ten and twenty years ago would be laughed at, ridiculed by 75 per cent of the foundrymen of this country, I might say possibly 75 per cent of the foundrymen of the world, are now generally accepted. The demonstrations which we have had, both as regards the construction of machinery for the betterment of foundry equipment and work, and also the untiring energy devoted by our metallurgists and chemists in the investigation of those physical laws which shall bear out towards the advancement of our iron, steel and brass industries, have brought before the people of America and before the world the fact that the iron, steel and brass and metal industries generally are as yet merely in their infancy, and there will be some wonderful developments in the few years to come. I won't trespass upon you by taking up more of your time. I am just about run down myself. I have been a pretty busy man lately and my ideas and words come rather slowly to me this morning on account of late nights. But I want to thank the Association for the kindness, and I appreciate very, very much the honor conferred upon me. I will do to my utmost everything I can to advance the interests of the American Foundrymen's Association and keep it upon the dignified plane that it deserves to be held upon. I think everybody has been impressed with the fact that this Convention has been a most dignified Convention. Everybody has been pleased with the personnel of the foundrymen, and their conduct of themselves has been an example which might well be followed by any Convention. Everything has been pleasant in every way. Again I thank you very much for electing me President. (Applause.)

DR. MOLDENKE: Mr. President:—There is only left now in the way of business the location of the next Convention. We have before us letters and I think we have present gentlemen who will speak for the various cities. Probably Cincinnati is the first in line.

THE PRESIDENT: The next order of business will be the next Convention city. The matter is now before you and we will call for the designation of such a city by any who wish to do so.

MR. FINCH: I am here, Mr. President, representing the City of Cincinnati. Possibly some of you may have observed during the week that Cincinnati wanted the Convention. We have tried

to spear every delegate we could with a button, and I am happy to say I see some evidence of those buttons.

I come, Mr. President, with proper credentials. I have here a letter from the Cincinnati Convention League, the usual and formal letter of invitation, which I shall not tire you by reading. It merely expresses the hope that the 1909 Convention of the American Foundrymen's Association and the allied Organizations will be held in the city. The League represents the business and professional members of Cincinnati and Ohio. This is backed up by the following from the Honorable, the Mayor to the American Association and allied Organizations:—"Being informed that the Cincinnati league, which represents the commercial and professonal men of the city, propose to invite the American Foundrymen's Association to hold their Convention in 1909 in Cincinnati, I beg to say on behalf of the Municipal authorities that the gates of Cincinnati are always open to strangers and that the most cordial hospitality will be extended to the Association. We shall esteem it a special compliment if your Association decides to act upon this invitation." I have here a letter from the President of the Cincinnnati Chamber of Commerce, which has a membership of 1,000. Also a letter from the President of the Businessmen's Club. I beg to leave these with you as my credentials and as a formal invitation.

When I came to Toronto I expected to have in competition with me people only from cities in the United States. Since I have been here, however, and participated in the very royal entertainment you have had, I begin to be afraid at last that possibly you might want to come back to Toronto next year (applause. Now, however, that you have honored Toronto by making one of its citizens your President. I think the next nicest thing will be to honor Cincinnati with your presence next year. We have everything down there, gentlemen, that you could possibly need for your Convention purposes. Within the last few years we have very materially increased our hotel accommodations, we have built two modern fire-proof elegant hotels with combined accommodations of some 700 rooms. We have beside those something like 30 other hotels, and we can assure everybody comfortable housing, and there will be no occasion for increase in rates. We have excellent facilities for getting to and from Cincinnati, speaking both of passengers and freight, so, wherever

you live, unless you are in Toronto or Boston, you are within a nice ride of Cincinnati. You can leave your business in the evening and be in the Convention next morning without loss of time.

The facilities for the Foundry Supply Association and the exhibit which is so much a feature of your Convention I think you will find perfectly ample and good. Fortunately the Secretary of one of the Associations has been to Cincinnati and inspected the situation, and he has assurred us that everything will be satisfactory in case the invitation was accepted. The exhibits would be within about 10 minutes' walk of the leading hotels in the City, they would be next door to our largest and best Convention Hall, known as the Music Hall, and in the hotel I referred to there is a Convention Hall also which will seat 800, in another hotel we have another Convention Hall that will seat some 500 so that the meeting facilities are sufficient, and you would be in the position of having your meeting place and your display close together.

Now, I have dwelt a little at length on the facilities, because I felt you were interested in them, and I don't know as I need go any further into that. I believe—I may be overconfident—but I believe the sense of the meeting is for Cincinnati next year, and I am going to rest rather comfortably on that.

Here in Toronto you have been stopping at the King Edward and riding out King street for the Convention, you have been on Queen street, you have seen the House of Parliament, and from what I hear some of you have even been closer to Kings and Queens than that while here. Altogether you have had a good bit of royalty along with your royal time. Down in Cincinnati we have a Prince too, he travelled around the country, and some of you, I expect, know him. I don't know whether we can resurrect him or not, but in any event if you come to Cincinnati we will guarantee you a princely and real good time.

I hope the official mover of the Convention, Mr. Field, will move the acceptance of Cincinnati. (Applause.)

THE PRESIDENT: You have heard Mr. Finch's motion. Now, is there anyone who wishes to suggest another city?

MR. JAMES H. DEANS: On behalf of the Board of Trade of Wheeling I wish to extend an invitation to this assembly to meet and have their next Convention in our City.

Wheeling is perhaps not as large as some towns and cities you have been holding these Conventions in, but I feel sure we can make up in hospitality what we lack in size. We have excellent arrangements for taking care of a Convention of this kind, both in the way of your exhibits and your Convention meetings. We can provide for you, and I am sure we will be glad to have you consider Wheeling in making up your selection for the next Convention.

I have a formal invitation from the Board of Trade, our business organization of that city, which I will present to the Secretary, and I feel sure that we will be able to take care of the Convention.

Dr. Moldenke: Mr. Chairman: I would like to say that the question of location of Conventions is very interesting now. Three or four years ago we had to look round to find where we could lay our head over night; now we have a request from Cincinnati, we have offers from Detroit for the year after, and Pittsburg thereafter; Wheeling is good enough to invite us and Niagara Falls also wants us, so it looks as if for the next five years we are amply supplied, provided you want to accept these invitations.

I would say further that with regard to the location for next year, it is customary to leave that to the Executive Board, but the Convention generally recommends the place. I would say with regard to Wheeling that it has also been customary that the cities get in line in good time, so probably we will not go to Wheeling next year, but it will be on the list for a future occasion. I therefore move that the location of the next Convention be left as usual to the Executive Committee with the rcommendation that Cincinnati be chosen.

Mr. Zimmers: I beg to second that.

The motion was then put and carried unanimously.

Dr. Moldenke: I think we have representatives here from both Detroit and Pittsburg, and I suppose we would like to hear from them, probably Detroit first and Pittsburg next, so tnat it may come officially on the minutes.

Mr. Wilson: I have the honor of being the Vice-President and Chairman of the Executive Committee of a local Foundrymen's Association in Detroit, which was started several months

ago. It has quite a membership and is growing fast. We had in mind when we started this Association of ours that it was best for the Detroit Foundrymen to get together for educational purposes and work along the lines of the American Foundrymen's Association. We also had in mind that as Detroit is well adapted as a Convention City a visit from the American Foundrymen's Association would be very acceptable to us as well as to the City and foundrymen at large. At one of our meetings we took this matter up and I was authorized to extend an invitation to the American Foundrymen's Association to hold their meeting in Detroit in 1910. I wish to say further that the matter was taken up with the Board of Commerce and with the Convention League and foundrymen in general, and that your worthy Secretary and the Secretary of the Foundry Supply Association have both been in Detroit and looked the situation over, looked over the place for the Foundrymen's Convention, which is the City Fair Ground, located 30 to 40 minutes' ride from the City Hall in a straight line, and the car service is excellent. The facilities there for loading and unloading the supplies and exhibits are excellent. The grounds and the buildings were pronounced by both Secretaries to be equal to any. We felt so sure that Detroit might be selected for the Convention in 1910 that we have already engaged the City Fair ground for the first week in June 1910, and we have already made arrangements with the Street Car Company for a single fare out to the grounds, it now being out beyond the limits and calls for a double fare.

On behalf of the Foundrymen's Association of Detroit I wish to extend this invitation to the American Association to hold their Convention in Detroit in 1910, and I think I can assure the Doctor that the police on Belle Isle will be blindfolded during that time. (Loud applause.)

Note by the Secretary: This refers to the visit in Detroit when the automobile ride tendered the secretary was interrupted by the arm of the law in the shape of a policeman—for speeding.

The President: The motion is, I take it, that the question of the Convention being held in Detroit in 1910 be referred to the Executive Committee, with power.

Seconded and carried.

Dr. Moldenke: I think we would like now to hear from Pittsburg, who, I believe, are very strongly in favor of getting us there in 1911.

Mr. Field: Mr. Chairman: I am not going to take up any time this year, because next year we will have something to say, and the year after that still more. I may say this: In spite of what my friend from Detroit has said, I think there are better places than Detroit to hold this Convention in, and while we think that Pittsburg should have had it in 1910, we very gracefully yield to Detroit.

As those of you who have been in Pittsburg know, we have a building in the very centre of the city, within 5 minutes of any hotel, which is known as Exposition Building. It is the only permanent exposition in the country we know of that is open every year. There is a machinery hall in which you can install machinery of any size; there is in connection with this a large nall which is capable of seating 4,000 to 5,000 people; and besides that two or three small halls which could be used for meeting purposes, all under the same roof and within 5 minutes of any of the hotels. I do not believe for purposes of this kind there is a building in the country which is equal to it. There were some of you in Pittsburg at the last Convention, so I don't need to tell you what Pittsburg can do. Those of you who were there remember that very well.

In bringing this matter before the Pittsburg Foundrymen's Association they all stated and seemed very glad that the Association would come there again, not without appreciating the very large amount of work before them, but feeling sure that having you all with us in 1911 would more than pay for any work which may fall upon the local organization for that time.

I am not going to make any motion this time, it would get a little stale by next year. I simply state this, and next year I will have something more substantial in the way of documents from the Mayor and Government, and possibly from Mr. Taft. (Applause.)

The President: Well, I can only say that on behalf of the American Foundrymen's Association we appreciate very much the interest that is being evinced on the part of many of the cities in inviting us for our Conventions. As the Doctor said,

A short time ago it used to be difficult to get anybody to take us; now everybody's hands seem to be extended, and we feel complimented.

As Mr. Field suggests, we can think over Pittsburg for 1911, and I suppose he will bring, as he says, proper credentials later on.

Now, gentlemen, is there anything else you wish to bring before the meeting? If not, a movement for adjournment is in order.

A MEMBER: I move we adjourn. Seconded and carried.

The Convention then closed.

THE SMOKER.

The American—pardon—United States visitors will long remember the unique features of an English Smoker. Held in one of the large auditoriums of Toronto, draped in a wealth of flags and bunting, with the legend "God save the King" prominently displayed as an evidence of intense and respectful loyalty, it was a genuine treat to be welcomed with a hospitality that knew no bounds. If the gathering on ship board was large, this one was more so, being really the welcome of Toronto to the Supply Association with the other Associations as interested participating guests, the pace was a furious but extremely good natured one. Every one enjoyed himself to the utmost, and when brother Benjamin carried off the honors of the Band Leadership contest in an inimitable style to the strains of martial music, it was as if the mantle of the Macabees of old had descended upon his shoulders. The audience rose as one man and shouted itself hoarse in his praise, and the price of scrap soared.

The dainty little Highlanders seemed to divide time into sixty-fourths without the least trouble, and threw in a few syncopations in a way which would have made Bobby Burns envious. The audience certainly felt that way, and applauded until the roof was in danger of lifting. "Harrigan" was let loose, and so was the Ambrosia with a collar on it. Our genial President-elect had immortalized the Secretary on the back cover of the Programme, and so even the hotel bell-boys knew him on his return home.

The rather novel features of the evening were the sparring

matches, so dear to the heart of the Englishman, but more or less unknown further South. While the claret—as the dime novel has it—flowed, once or twice, the spectacle was an interesting one in view of the Japanese situation, and the presence of His Worship assurred the legality of the entertainment.

Many were the interesting numbers on the programme, as well as the improvised ones in which brothers Baumgardner, Smith, and Beers figured to the delight of the audience. We must also not forget the picturesque and important services of the only Cummings as referee.

It was late in the evening when the jolly crowd broke up and went home. A most orderly and well enjoyed Smoker passed into history, and only a long file of "Indians" singing "Harrigan—that's me" woke the gentle sleepers of the King Edward until the stroke of twelve, everybody vanished, and Toronto was really and truly in bed.

The Convention had ended.

BOOK NOTICE.

The Secretary's office is in receipt of a copy of the General Index of "Stahl und Eisen" which will interest every one connected with the Iron Industry who has occasion to look up the progress of the art since 1881, and who is conversant with the German Language.

This general index for the volumes appearing from 1881 to 1906 is a very elaborate and thorough one, and as the Journal in question, the official organ of what would be called the German Iron & Steel Institute, is recognized as gathering everything worthy of record in our line of work, for the use and behoof of the German Industry, outsiders thereto will find a pretty candid and well balanced judgment of processes and events in its pages.

The volume may be obtained through dealers in the usual way, or direct from the business office of Stahl und Eisen, Duesseldorf, Germany.

REPORT OF THE COMMITTEE (B) ON TESTING CAST IRON AND FINISHED CASTINGS.

AMERICAN SOCIETY FOR TESTING MATERIALS.

(This report will be of interest to the members of the American Foundrymen's Association, in view of the action taken on the subject of specifications for Foundry Pig Iron.)

Committee B. would respectfully report for the year 1907-08 as follows:

Each one of the sub Committees has been communicated with.

The Chairmen of the Committees as follows, namely,

On Cylinders

On Car Wheels

On General Castings

On Testing Cast Iron

report that they have no changes to suggest in the specifications that were prepared some years since, and which were laid before the Society and after full consideration, duly adopted.

The Chairman of the Committee on Cast Iron Pipe makes a similar report, stating further, however, that the American Water Works Association, who have for the past few years been considering the adoption of Standard Specifications, and for that purpose have had before them the various prominent Cast Iron Pipe specifications used in the United States, did at their Annual Convention last May adopt a Standard Specification for their Association, which (in but one or two small points) is identical in language and form to that prepared by this Society.

This action by the American Water Works Association in virtually adopting your specifications opens the way to a final form of specifications for Cast Iron Pipe in the United States.

The Pig Iron Committee held a session at Columbia College during the winter, and submit the following:

"The Committee on Standard Specifications for Foundry Pig Iron believing that as buyers are now so largely basing their contracts upon analysis, and that those who are still adhering to the old nomenclature of grading fully appreciate the analysis which such grading indicates, have concluded that the time has

come for proposing that hereafter pig iron shall be always bought by analysis.

Hence in abandoning grading by fracture for buying by analysis the specifications issued by an Association such as the American Society for Testing Materials should be stated in the broadest possible terms.

It therefore becomes necessary only to determine the percentages of each element, the variations therein, and the allowed departures therefrom, together with definite modes of sampling and reaching adjustments of such differences as may occur.

They therefore submit the following tentative specifications for consideration by the Society.

STANDARD SPECIFICATIONS FOR FOUNDRY PIG IRON.

ANALYSIS.

It is recommended that all purchases be made by analysis.

SAMPLING.

Each carload or its equivalent shall be considered as a unit.

At least one pig shall be selected from each two tons of every carload, and so as to fairly represent it.

Drillings shall be taken so as to fairly represent the fracture surface of each pig. The sample analyzed shall consist of an equal quantity of drillings from each pig, well mixed and ground before analysis.

PERCENTAGE OF ELEMENTS.

Opposite each percentage of the different elements a syllable has been affixed so that buyers, by combining these syllables can

form a code word to be used in telegraphing such inquiries as they may desire to make.

Silicon		*Sulphur*	
Percent	Symbol	Percent	Symbol
0.50	Ca	0.04	Sa
1.00	Ce	0.05	Se
1.50	Ci	0.06	Si
2.00	Co	0.07	So
2.50	Cu	0.08	Su
3.00	Cy	0.09	Sy
.25 Allowed variation		maxima gravimetric method	

Phosphorus		*Manganese*	
Percent	Symbol	Percent	Symbol
0.25	Pa	0.50	Ma
0.50	Pe	0.75	Me
0.75	Pi	1.00	Mi
1.00	Po	1.25	Mo
1.25	Pu	1.50	Mu
1.50	Py	1.75	My
.125 Allowed variation		.125 Allowed variation	

Example:

Code Word	Sil.	Sul.	Phos.	Mang.
Ci-se-pi-ma represents	1.50	.05	.75	.50

These specifications were laid by Dr. Moldenke, the Secretary of this Committee, before the meeting of the Foundrymen's Association at Toronto, held this month.

They received earnest consideration by that body, which passed the following resolutions;

Resolved:—That the American Foundrymen's Association in Convention deprecate the use of grade numbers of any kind in Specifications for Foundry Pig Iron, and go on record as favoring specifications by chemical analysis only.

Resolved:—That the American Foundrymen's Association requests the American Society for Testing Materials to cooperate with it and other Foundrymen's Associations, in bringing about

specifications for Foundry Pig Iron along the lines of the preceding resolution.

Following the above resolutions Dr. Moldenke, as acting for the Foundrymen's Association, suggests that the American Society for Testing Materials meet the Foundrymen as requested and that the Society at this meeting pass the following resolutions,

Whereas, The American Foundrymen's Association has asked for cooperation in bringing about specifications for Pig Iron on the basis of chemical analysis,

Resolved:—That Committee B. be authorized to join with the American Foundrymen's Association and similar Associations in the preparation of specifications for foundry pig iron.

Your Committee would therefore request, in accepting their report, that such resolutions be adopted, as action on these lines will bring together those handling Pig Iron in such a way that specifications will be agreed upon which will permit of universal adoption by both buyer and seller.

There is no report from the Committees on the

Influence of the addition of Special Metals to Cast Iron,

Micro-Structure of Cast Iron.

All of which is respectfully submitted.

WALTER WOOD, Chairman.

The above report was received and ordered filed. The Resolution above given was duly passed. Mr. H. E. Field, the chairman of the A. F. A. Committee on Specifications for Foundry Pig Iron is now at work getting together his committee, and promises early results.

A CHAPTER FROM THE GUILDS OF THE MIDDLE AGES

By P. KREUZPOINTNER, Altóona, Pa.

The work we are doing serves as a foundation for the work to be done by those who come after us. Each generation that has passed from the world before us left some experience, and we of today enjoy the benefits of the accumulated experiences of past centuries of human activity.

We will appreciate the part our ancestors took in the development of modern industries all the more if we see how the people and especially the mechanics worked in bygone days, hundreds of years ago, when there were neither railroads nor steamships nor streetcars and often times no roads at all.

When every city was a territory for itself, subject to no one except the emperor, the citizens ruled their territory with an iron hand. In those days, at the time called the Middle Ages, including the period from the eleventh to the seventeenth century, every trade and every occupation in the cities was highly organized, forming what was called a guild, or association of masters of a trade.

There were not only trade guilds and merchants' guilds, but there were soldiers' guilds, schoolmasters' guilds, students' and professors' guilds, and even the beggars and prostitutes had their guilds and were guided and controlled by guild rules.

In the Roman empire guilds were recognized by the emperor 800 years before Christ and they were exempt from taxation. There were guilds of builders, painters, sculptors, architects, gold-, silver-, copper-, lock-, and blacksmiths, stone masons, bricklayers, carpenters, wagoners, carvers, lead workers, mold-

Figure 1

ers, surveyors, mechanicians, die sinkers, plasterers, glaziers, potters, gilders, furrier's, looking glass makers, bed makers, purple dyers, coiners, laundresses, drillers of pearls, well diggers and decorators.

The members of the guilds were all armed and in time of need joined into regular armies. In the war between France and the Netherlands, during the eleventh century, a brewer of the city of Ghent commanded an army of 80,000 men. At times

Figure 2

the guilds were so powerful that, when there was no ruler in Germany, in 1260, because the dukes and princes were at war with one another, not being able to agree upon an emperor, the guilds of the cities on the Rhine took the government into their hands and for twelve years a committee, selected from the guilds, governed the empire successfully. What made the guilds so powerful?

Under the reign of the Roman empire the guilds were cod-

dled, but yet effectively controlled, by the government since the mechanics of the time were slaves or dependents in one form or another. Even the artificers in the Roman army were formed into guilds and these guilds were given privileges for better centralization of the government. On the other hand, after the downfall of the Roman empire, when the countries of Europe emerged from the Dark Ages and there were no states or countries with a centralized government, but there were innumerable

Figure 3

little dukedoms and principalities, who were often more powerful than the kings and emperors, whose power was only nominal; then the cities formed their own governments; fought the robber knights and barons and lent money and aid to the emperors against their unruly vassals. In return the emperors gave the cities valuable privileges of one kind or another. For

instance, the legal right to collect debts within a hundred or five hundred miles from the city thus privileged.

Within the cities the trades formed themselves into guilds to improve the workmanship of the members of the trade, control the quality as well as the quantity of the work done, and subject themselves to rigid rules and regulations concerning their religious and moral lives and mode of living. All members of the various guilds were armed, as were the workingmen, and all were under military discipline, with their swords or hellebards lying by their sides, while at work, to be grasped at a moment's warning from the watch upon the city wall.

Figure 4

To do good work was an honor and duty and those who tried to cheat in weight or measure or with dishonest work had to pay heavy fines, were deprived of their rights, or, in aggravated cases had their ears or hands cut off and sometimes their heads.

On the other hand the guilds protected their members to the fullest extent of their power, supporting them in evil days, in sickness and took care of their families after death. To secure to each sufficient and permanent work no master was allowed to have more than four journeymen and two apprentices at the most. No one was allowed to take work on contract or finish work which a dissatisfactory customer had taken away from a fellow member of the guild, or in any way injure his rival.

Figure 5

In fact there was no rivalry except in the quality and honesty of the work done since it was the fundamental principle of the guild to secure equal prosperity to all its members.

The apprentices boarded with the master who had absolute control over their mental, moral and physical wellbeing. He could maltreat them and whip them, only need to be careful that no blood would flow.

To show you an example of the power of the guilds I will

tell you that, when I learned my trade more than fifty years ago the old guild laws, regulating the inner life of the guilds, were still in force in my country.

My master was a cruel man and he whipped us two boys every working day in the year on general principles. Once I made a mistake in the work and he pulled my ear partly off and knocked me to the floor senseless with the blood flowing from my

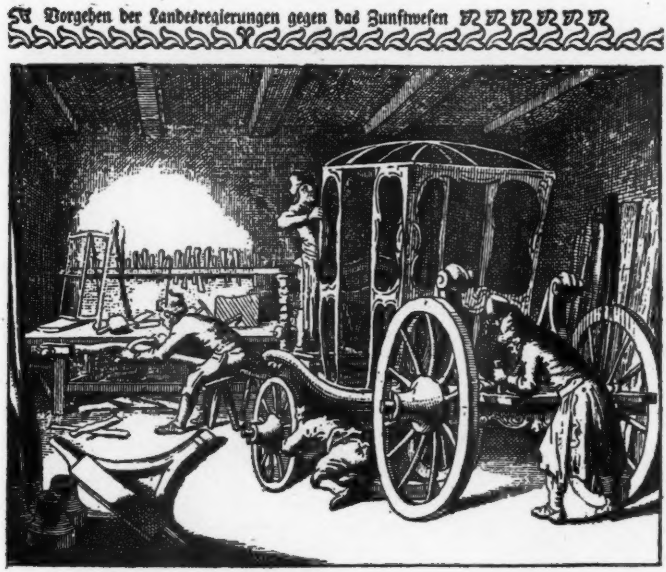


Figure 6

mouth and nose and ear. My parents were dead and my guardian, thinking that was too much, brought suit against the man. But the judge dismissed the case, saying, "Boys need a good whipping once awhile." But the guild took the matter up and stopped the abuse and for the remainder of our apprenticeship we never received another stroke, showing that the guilds, in those late days and within their own domestic affairs, as it

were, they were still more powerful than the law of the land.
This arose from the old time privileges received hundreds of

Abb. 28. Inneres einer Münzwerkstatt. Hinten rechts Kaiser Maximilian. Holzschnitt dem Hans Schäuflein zugeschrieben. Aus dem Weißkunig. Muther S. 124, 32.

Figure 7

years ago and which the States, after the decline of the power of the cities, did not dare to abolish outright until 1861 when the last remnant of the guild laws were wiped out of existence.

The government of the cities, of the Middle Ages, by the

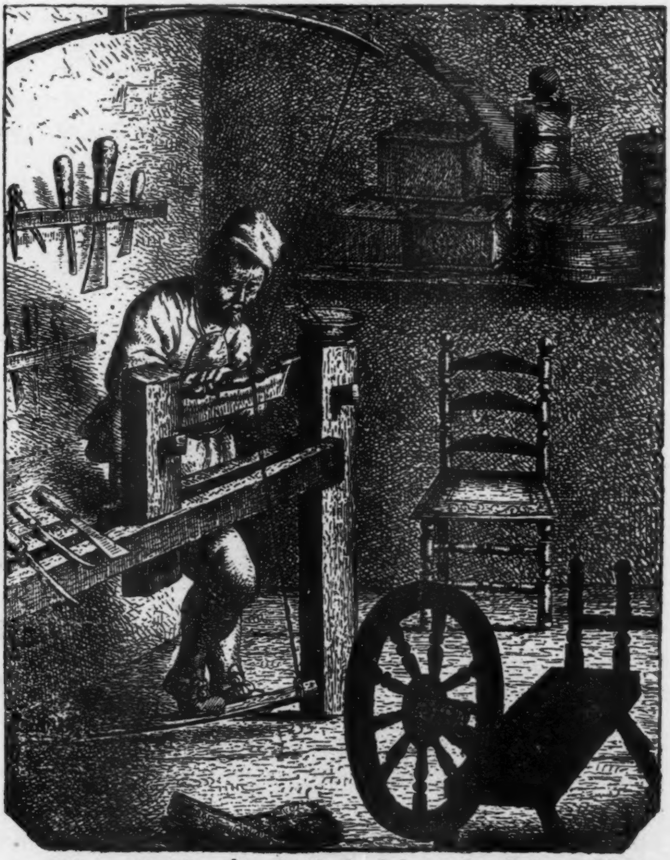


Abb. 77. Drechsler an der Drehbank. Kpfr. von Jan Joris van Vliet. 17. Jahrhundert. München, Kupferstichkabinet. B. 46.

Figure 8

guilds was highly organized and economical because they had also to provide for military expenditures. When, with the in-

crease of trade and transportation and intercourse between people, the States grew and the power of the individual cities declined, the States simply took over from the cities their method of government and enlarged it to suit the larger needs of the state. Some of our city officers today, like city controller and city solicitor, are the same officers as they were created and existed in the cities during the Middle Ages, showing that our an-

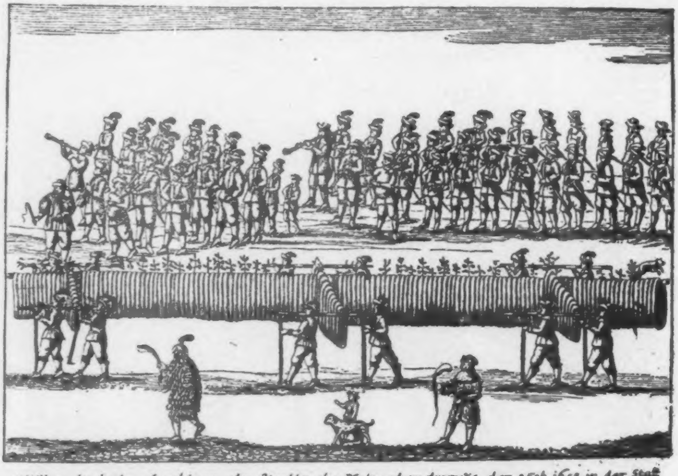


Abb. 123. Umzug des Metzgerhandwerks zu Nürnberg 1658. Kpfr. von Alexander Böner (1647—1720), Nürnberg, Stadtbibliothek.

Figure 9

cestors helped to build the foundation upon which we stand with our civilization today.

In figure 1 we have an epoch making scene in the history of the guilds when, in the year 1368, representatives of five

craft guilds in the city of Augsburg were admitted as members

Zierlicher vnd schöner Auffzug

Welcher von den Schreiner Gesellen zu Franckfurt am Mayn/ von den 14. biß 17. Febr. Anno 1659. öffentlich geschehen vnd gehalten worden.

Abb. 128. Umzug der Schreiner zu Frankfurt 1659. Gleichzeitiges Kpfr. München, Nationalmuseum.

Figure 10

of the municipal council of that city.

From the beginning of the rise of cities during the tenth cen-

Beilage 8. Lehrbrief des Johannes Mieseler, aus[...]ng zu L

Chur Fürstl. Sächßl. Handels Stadt Leipzig;

...beysitzer, eines Erbaren Tischler und Büchsenschiffter Handwercks.

...g zu Leipzig 1714. Nürnberg, Städtisches Archiv.

Figure 13

tury the government of the cities was in the hands of the merchants' guilds. As these guilds became powerful with the growth of the cities their government grew to be arrogant and extravagant and the growing craft guilds demanded a share in the city administration. Thus, a struggle for power arose in all cities of Europe, lasting more than a hundred years, causing

Figure 11

sometimes bloody revolts, until finally, little by little, the craft guilds got the upper hand and either wholly ousted the merchants' guilds or they divided the city administration between them, creating the select and common branches of city government as we have them today; with the merchant guilds forming the upper and the craft guilds the lower branch of the councils of cities.

Fig. 2 shows a smithshop of the 14th century.

Fig. 3, a maker of flexible armor or chain armor.

Fig. 4, a timble maker.

Fig. 5, a bow maker.
Fig. 6, a wagon maker shop.
Fig. 7, a coiner or money maker.

The right to coin money was exercised either by the kings or dukes, or cities or guilds were given the privilege to coin money.

Figure 12

Thus throughout the Middle Ages the goldsmiths were the bankers and frequently also the coiners of the land. Those cities which kept their money at the highest standard and free from debasement and fluctuating value had the best credit and their

Figure 14

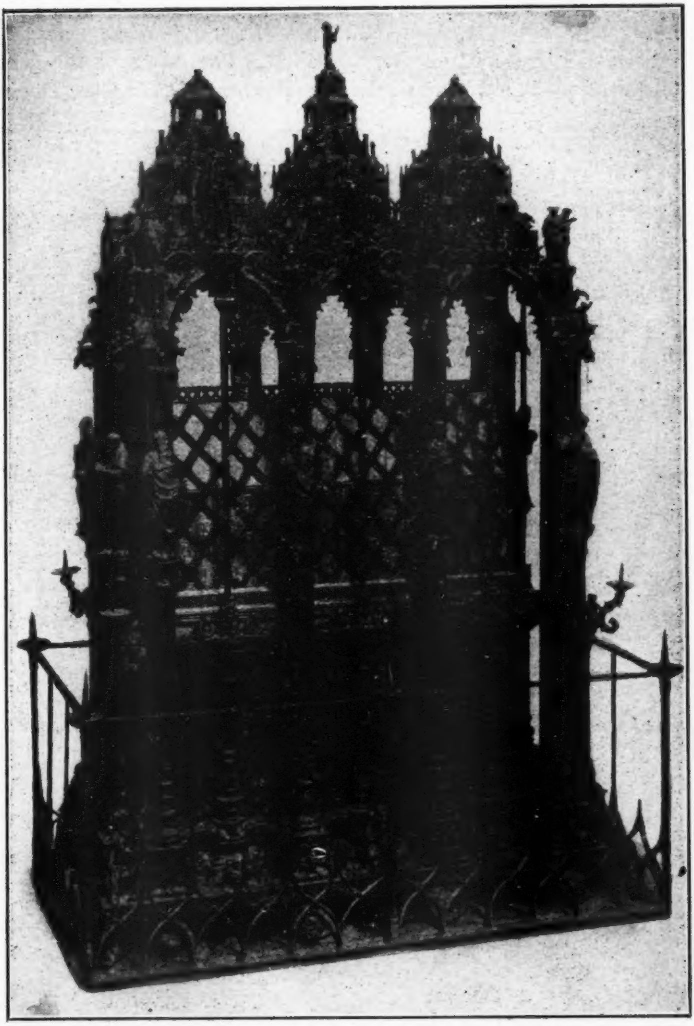


Figure 15

guilds had the best trade. Sometimes the money of one city was worth only one third the money of a neighboring city.

Fig. 8. This picture gives us a vivid impression of the difference of old style hand work and modern machine work. There

Figure 16

is a seventeenth century woodturner at work, treading his crude lathe thirteen hours a day with the hardest physical exertion, while in the modern machine the man touches a button or turns a crank and the physical exertion demanded is veritable play in

comparison with the exhaustive work to be done by mechanics in those days.

Fig. 6.—Armor of Christian II of Saxony.—Breast Plate.

Figure 17

Fig. 9. To offset this drudgery the workingmen of those

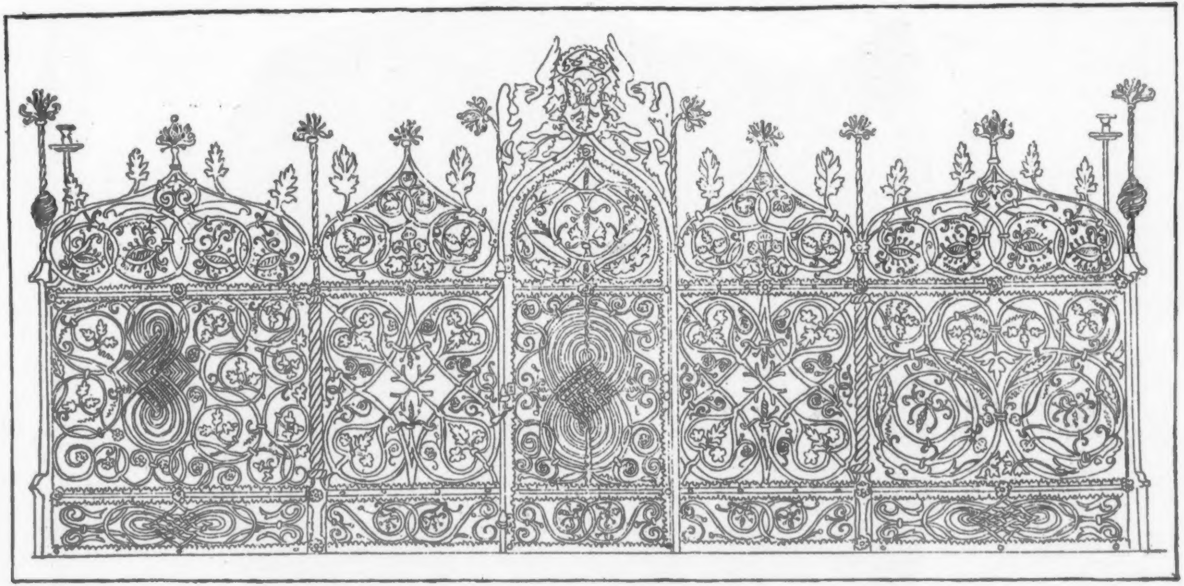


Figure 18

days had frequent holidays and celebrations of one kind or another.

Thus, in 1658 the butchers of Nueremberg conceived the idea of making the longest sausage ever made and they tried to make one 2,000 feet long. However, they succeeded in getting one only 1,900 feet and this sausage the butchers carried on poles through the streets of the city and in the evening, at a public banquet it was eaten up.

Fig. 10. shows a procession of the cabinet makers of the city of Leipzig in 1659.

Fig. 11 shows the excitement caused by taking a steer to the slaughterhouse.

Fig. 12. The changing of a journeyman from one master to another was always an undertaking accompanied by some ceremony and red tape and no journeyman could hope to get work without a duly signed discharge by his former master, countersigned by the master of the guild. Such a certificate is shown in Fig. 12, giving name, age, place of birth, color of hair, place of work, and behavior of the man, signed by the master he worked for and countersigned by the master of the guild.

Fig. 13. But taking on an apprentice and discharging him after he had served his time was a very elaborate and solemn procedure indeed and the extensive testimonial, a facsimile of one as given here, where the fact is duly set forth how the parents of the boy had made proper and lawful application to the guild to have the boy solemnly indentured in the presence of witnesses and the prescribed formalities, how the boy had proven an honest, obedient, faithful, pious, industrious, skillful young man, and now may go forth into the world to be an honor to his trade, his guild and the city he was born in, and he is hereby recommended as a worthy member to all masters and journeymen of the guild of cabinet makers. Signed by three head masters of the guild and three councilmen of the city of Leipzig in the year 1714.

Fig. 14 represents a cast iron stove of the 18th century.

Fig. 15 is a master piece of the art of bronze founding, weighing two tons. It is a monument in the Sebaldus church at Nueremberg, Germany.

Fig. 16 and 17 is a helmet and breastplate of steel, inlaid with

gold. It was made 300 years ago for the king of Saxony and is one of the finest pieces of Mediæval handycraft art in existence.

Fig. 18 is a wrought iron gate of the 16th century.

American Foundrymen's Association.

A SUGGESTED CHANGE IN CUPOLA PRACTICE

By Dr. R. Moldenke, Watchung, N. J.

In the last few years considerable has been written on the subject of imperfect castings, and many and varied have been the reasons advanced to account for the existence of pin, gas and slag holes, interior shrinkages, draws, cracks, and the like. The suppositon that these undesirable manifestations are solely due to molding troubles, bad sand, air in the molds which can not escape fast enough, bad design, or an improper mixture of metal, does not always convince the experienced foundryman. He has, however, no other recourse than to correct what he can in his practice as he sees it, and trust that he will soon run out of his bad run of luck. Usually by the time things begin to get irritating, the castings have all been made, and the trouble is forgotten for the time being.

For a number of years it has been my feeling that aside from causes easily seen and remedied, the fundamental difficulty in nearly all cases of imperfect castings, lies deeper and may be found directly in the manner in which the stock is melted down. In other words, that there is something about every melting process, whether cupola, air furnace or open hearth, that must be taken into account, otherwise a greater or less number of the castings made will show spongy spots, pin holes, etc., when machined.

It is the purpose of this paper to go into the subject a little, to try to give the probable cause, and suggest a remedy for much of the above mentioned trouble.

Foundrymen will remember that several years ago a very elaborate series of cupola melting tests were made at the Government testing plant in connection with the St. Louis exposition, and the year thereafter. I was in charge of this work, and present at nearly every individual test, and hence could observe the peculiar behavior of the several cokes tested out. A large number of cokes made on the premises from coals gathered all over the country, and selected specially for their probable usefulness for foundry purposes, were run through two small cupolas under standard conditions, and results noted. The series of tables subsequently published, while giving the coal producer information of direct value to him for his special use, also demonstrated a number of things for the foundry which would have been impossible to get in ordinary practice, as no one individual could afford to burn up a lot of valuable iron in order to derive information therefrom.

As these tests really form the basis for what is to follow, a few words in further explanation may not be amiss. The Technological Branch of the U. S. Geological Survey coked a great number of coals sent in by producers all over the country. Wherever these cokes showed a composition anywhere near foundry requirements, some was set aside for melting tests. In all some one hundred and ninety tests were made. Three thousand pounds of metal were melted in each test. In order to have uniform conditions for the coke bed, and still suit the average coke made, fourteen inches above the lower tuyeres was selected, and this height kept for every test. The upper tuyeres were kept closed. A melting ration of 7 to 1 was adopted. The coke used for the bed was weighed as put in to the proper mark. In this manner, measuring the height of the bed by a wire and weight dropped in, the exact amount of coke used could be noted. This weight varied from 180 to 230 pounds, showing quite a range in specific gravity. Four times this weight was charged in metal for the first charge, and the successive charges of coke and metal remaining to hold the ratio at 7 to 1 divided up

into four parts, coke varying from 50 to 62 pounds, and the metal correspondingly.

Blast was put on—about 7 ounces—and the time noted when iron began to show at the spout. Iron came in 5 to 15 minutes. This is interesting as indicating the rate at which coke was consumed, and the iron brought into the melting zone. With the best results the iron came in 7 to 10 minutes.

Necessarily for the extremely light and the unduly heavy cokes this melting practice would spell disaster, and it did so, the melting loss showing this up very markedly. Possibly this may convince many foundrymen who think it impossible to burn iron in the cupola. The results show this melting loss to be from 3.2 all the way up to 52.5 per cent of the metal charged. The cupolas were constantly slagged off, but in the worst case above mentioned, so much slag was made that it flooded the tuyeres, and effectually stopped operations. When bottom was dropped, there was no metal remaining. It was quite evident that with the lighter varieties of coke, they burned away so fast that the metal came to the lower portion of the melting zone much earlier than it should. Hence metal was burned directly by the blast. The first heavy charge, in melting, lowered this coke bed to a point which not only ruined the metal melted, but also prevented the subsequent charges of coke from restoring the bed to its proper level again. The burning therefore continued, and a very bad heat resulted.

Now taking the very heavy cokes. Here it was necessary to wait quite a while before the bed had burned low enough to begin melting. Necessarily to keep the ratio of one to four for the first charge, a very heavy one resulted. Here again the coke bed was lowered unduly in melting this first extra heavy charge, again bringing the metal too close to the blast. Result—burnt metal. The trouble in such cases, however, was aggravated by the fact that the subsequent coke charges were very small—too much having gone into the bed and being burned away without effect, remembering that the ratio of 7 to 1 was maintained in the heat. Hence again difficulty, and bottom dropped with a lot of unmelted pig iron remaining. The fuel became insufficient to even support the Bessemerizing influence of the blast.

So it will be seen that where the melting process with a given

coke and conditions normal gives good iron, it does not necessarily follow that any other coke will act the same, and hence many are the mistakes made in using new varieties of coke in a foundry without studying the conditions that should obtain to get results from them.

A word about burning iron in the cupola. Those who have watched the making of the iron silicates can realize how very little silica can carry great quantities of iron to make a thin black slag. In the heating shop where steel or wrought iron billets are gotten ready for the hammers, this process can be watched very nicely. The regenerative system of heating the modern furnace keeps things intensely hot in them, and as the billets become red and then white hot the metal oxidizes and wastes away rapidly, uniting with the sand bottom to a rich silicate, which flows out of the back of the hearth in a steady thin stream. This material is prized by the blast furnace as a wash and is easily 60 per cent and over in iron content. In the bottom of the open hearth furnace, after a malleable heat, oftentimes pools of iron remain which rapidly oxidize, burning with a display of fine sparks, to disappear after uniting with the sand bottom as a dark spot on a fiery surface. Of the Bessemer process nothing need be said here, as the burning of the metal is a self-evident proposition, though theoretically the iron goes last. In the blast furnace one has only to note that the same sized furnace which produces 250 tons a day under one set of conditions, and makes good honest iron for the foundryman, is made to yield double the amount in another place, with a corresponding diminution in value to the foundry. Some of the metal made gets oxidized before arriving in the crucible. In the cupola it is a simple thing to watch the scintillations from the drops of iron falling through the coke bed. Every little shot is thus coated with a skin of oxide as it passes the fresh blast and goes into the bath below. Just how much this oxidation amounts to depends upon the position of the stock with reference to the melting zone, as the material runs off molten.

Whether the blast first attacks the lining and this eats up the oxidized metal, or the oxidized metal unites with the ash of the coke, needing so little silica, matters very little. The slag formed eventually gets blown upward and to the sides, the rich iron

oxides greedily eat the lining, and great quantities of slag result. In the case above cited where the melting loss was over half the metal charged, the slag contained 43.50 per cent iron.

A study of the St. Louis results leads one to look into the melting process a little. Melting in the crucible has always given the best results, and simply because the oxidizing influences are at a minimum. In the air furnace, proper attention to the melting, and doing away with the thin edge of molten metal on the sand bottom, by making this approach the open hearth shape more, does away with much of the oxidation resulting in weak metal. In the open hearth as well as the air furnace, the reduction of the time in melting does more than anything else to keep the quality of the metal up. To reduce this melting time means a first-class knowledge of the process.

In the case of the cupola things are more complex. It is necessary to see what functions each part of the operation serves. Take the coke bed; this may be divided into three parts. The first is that portion below the tuyeres which serves as a filling. It occupies the space intended to hold the molten iron, and holds up the balance of the charges. The second portion of the bed is that just above the tuyeres and up to the zone of melting. In this space the blast has its oxygen more or less converted to carbonic acid and carbonic oxide. The third portion is the incandescent coke at which the actual melting takes place. The second and third portions of the coke, of course, shade into each other, the temperature of the coke rising from the comparatively dull heat of the bottom filling, to the hottest part at the melting line. As the metal melts, this line—if it may be so-called—naturally drops downward, and when all of the first charge is gone, the first intermediate coke charge gets on the bed, bringing it upward again. The second charge of iron is melted, the bed dropped in so doing, and again the next intermediate coke charge brings it up again. And so on. On the nicety of the charges depends the rate of melting, melting loss, and a number of other things.

That practically only the portion of the coke above the tuyeres does any melting is proven by that fact that in many foundries where it is not desired to hold any metal in the cupola at all, the tuyeres are placed a few inches from the bottom. Again,

that the lower portion of the coke above the tuyeres is also not effective for good is shown by the damage done when the iron gets too low. Hence the upper part only of the coke charge should be counted as effective, and study be given it to see how it can be made most so.

The first question that presents itself to the thinking mind is why—if only the upper part of the coke bed does the melting, and this part being used up in so doing, is replaced by the small coke charge above—why is the first charge in cupolas made heavier than the rest? It seems unreasonable, in fact absolutely incorrect to do so. Think a moment—iron does not begin to melt until the coke has burned down to the proper point. It takes more coke burned away after melting starts, to care for a big first charge, than for a little one, such as the ones subsequently used. Therefore with the big charge, the coke bed has been lowered so much that the subsequent coke charge does not restore the bed to its original height—in fact far from it. The second iron charge therefore does not begin to melt where the first one did, but much below it. Result—burnt iron in both cases. This goes right on for every succeeding charge, the latter end of each being too low and near the blast which at this low point contains a lot of unconsumed oxygen. Usually we find that the intermediate coke charges are just a little large, and gradually the line of melting is brought back to where it should be, and hence the burning trouble is confined to the first part of the heat. One often hears that toward the end of a heat the iron comes slow, and by cutting the coke in the last charges a little, quicker results are obtained. This is simply due to the extra large coke charges bringing the bed above the melting line, and hence coke must be burned away to get the iron into the proper place again for melting.

The conclusion that one must come to—if the reasoning is correct—is that the first charge shall be no larger than the others succeeding.

The second thought that comes from this is the natural result of the first, and that is—if the unreasonable fluctuation of the melting zone produced by an excessively large first charge does damage to the metal, then why not make all the charges not only alike, but as small as it is possible to make them, in order to

hold the melting line as constant as possible.

Herein lies the change I suggest in cupola practice as it is carried on today. I have tried this method repeatedly in the last year with remarkable results, nearly all the imperfections mentioned in the beginning of this paper being wiped out wherever the charges were made very small, the bed started off at the right height, and the intermediate coke charges proportioned in such a way that uniform melting resulted throughout the heat, and of course the chemical composition correct, and charging and melting accomplished with care.

The bed may be accepted as of proper height when iron comes at the spout in seven to ten minutes, the latter time being preferable. The charges are made so small that the proportionate amount of coke between just covers them and no more, say from two to four inches in depth. The ratio of iron and coke is kept just the same as previously in starting off this way, except that after deducting the coke for the bed from the sum total of coke charged, all the iron and all the coke left is divided up into equal and small charges. After running a while it will invariably be found that the coke can be reduced somewhat as the small charge system keeps the melting so uniform that the fuel formerly used in making slag and keeping it hot, is applied for melting iron.

It may be of interest to say that with cupolas of about 54″ inside diameter, the metal charges have been made as low as 750 pounds each, and with admirable results. In general, however, it is well to be guided by the coke between the metal charges, keeping this down to the smallest convenient amount, and making the metal charges proportionate to hold up the melting ratio. In this way there is a quick succession of coke layers to keep the bed right up to the proper level. In no case is the metal charge so large that the melting line is lowered very materially, and hence a minimum of iron is burned. The consequence of this is the practical wiping out of pin holes, the removal of draws, gas pockets, lessening of strains which mean cracks, and the closing up or rather prevention of spongy metal. All this, of course, not in its entirety, but in so great a measure that the discount is lowered to a highly gratifying extent. I could name case after case, where upon being called in to assist over such difficulties, this simple and logical—I think it—charging method,

has accomplished everything that could be desired. I take pleasure, therefore, in giving it to the foundry public, for their criticism and trial if they choose to do so. It may help someone who has castings to make which are machined and put under pressure tests.

I need not call attention to the greater uniformity in the mixture attained by this small charge method. This alone would commend it to the smaller jobber, who oftentimes has either no bull-ladle, or a very small one, holding say half of a charge only.

My own suggestion for charging a cupola, especially for big heats, would be somewhat on the following line:—Have the cupola cut off say six inches above the platform, and arrange a hood further up to draw off the gases. (This I believe is done in England in some places). Have a large cylinder slightly smaller than the inside diameter of the cupola, and provided with a drop bottom. Place the charges for the cupola inside this cylinder, or several of them, laying the metal, scrap, and coke evenly and carefully. Do this in your metal yard. Then transport to the cupola, run directly over it by some overhead method, and drop the charges squarely into the cupola. This will reduce the platform labor to next to nothing, allow the charges to be weighed by crane scale overhead, and laid right, and mean only one handling in the yard. It would be mechanical charging in its best sense, and rather more effective than the present blast furnace hoist. Moreover charging could not well be made any cheaper.

American Foundrymen's Association

PRELIMINARY REPORT OF COMMITTEE ON PREVENTION OF ACCIDENTS IN FOUNDRIES.

In connection with the study of accidents in foundries and the ways and means of preventing them, your Committee thought it best to first gather some statistics on the subject, so that the work in hand might be undertaken with some degree of certainty, and that the recommendations presented to the Association at the coming Convention, might be based on actual facts.

In accordance with this decision, the following general letter was sent out to every foundry in the United States and Canada, as given in Penton's List—6,366 in all—and each letter was accompanied by a blank report to be filled out and returned to the Secretary of the Association for compilation. A copy of the blank forms part of this pamphlet.

(Copy of Letter.)

Sharpsville, Pa., Sept. 1, 1908.

To the Foundrymen of America, Greeting:

At the recent Convention of the American Foundrymen's Association, held in Toronto, a committee on prevention of accidents in Foundries was appointed. The Foundry Industry, as is well known, offers peculiarly good opportunities for careless men

to get hurt, and hence, along with other lines of manufacturing and smelting, is the object of much Legislative solicitude. As a consequence a continually greater burden is being directed our way.

While the installation of necessary safety devices is highly commendable, much must naturally be left to the judgment of the operative and his superior, for there is a limit even to safety by mechanism.

One of the principal difficulties in the study of the prevention of accidents is the absence of any statistics which would indicate where to begin first, and how to work; and hence your committee requests you most earnestly to give your best attention to the enclosed blank, which is intended to show just how much of the loss of life and property is really chargeable to unsafe shop conditions as they exist today.

We beg you to fill out the blank spaces and return promptly to the Secretary, for tabulation and early publication. Names and items are confidential, only the summary will be given out.

Very respectfully yours,

THOMAS D. WEST, Chairman.

RICHARD MOLDENKE, Secretary.

The time selected was between July 1907 and July 1908. Accidents were divided into eleven classes, intended to bring out as nearly as might be, the conditions under which they occurred. Further, information was asked on the expense involved to the individual foundry in caring for the unfortunates thus afflicted. Finally opinions were requested to help the Committee formulate recommendations of value to the foundry industry and the manufacturing interests at large.

To the 6,366 letters sent out 1,084 replies were received, many accompanied with two page letters explaining the report made, and giving excellent suggestions in relation to the prevention of accidents in foundries. These suggestions will be carefully studied and the summary embodied in the final report of the

Committee next May. For the present only the results obtained from the statistical inquiry are given.

Your Committee can therefore report the accidents of 17 per cent. of all the foundries North of Mexico, including the Canal Zone and Hawaii. It was probably asking too much to separate the bruises from the burns, or to give the average number of employees during the year recorded. In most instances these points were not considered by the foundrymen in making out their reports. Hence this information, being too slight, is not collated here. It would be mere guess work to base any statistical work on it, and the tables submitted contain only actual facts as presented by the reports.

While practically 83 per cent of our inquiries were simply transmitted to the waste basket—a figure considered not at all bad by those who are familiar with the foundry world—only one letter was "refused," which was too bad, as that particular foundry must have had an "experience."

651 foundries report "no accidents," and the other 433 had a sum total of 5,242, eleven of which were fatal and four hundred and twenty-four serious. Of these 433 who had accidents, 345 report the cost to have been $29,838.42 and one foundry burned in toto.

Of the 1,084 who reported, 190 spent $48,679.58 for accident premiums, 114 report business for the period in question dull, 302 fair, and 71 good.

One foundry in Pennsylvania reports one man killed a few days before the period specified, as the result of smoking. This accident is not included in the list given, but attention is called to the fact that the use of tobacco may result in an accident on occasion, and probably when least expected. No one else seems to have had any trouble that way, however, many foundries reporting that they do not allow smoking under any pretext. Hence the space provided in the blank (No. 5) is omitted in the summary.

Numerous letters contained references to safety devices that had been introduced, and this will be gone into more in detail in the final report of the Committee. A salient feature, however, is the very large number of accidents attributed to personal carelessness. To this should be added some of those classified under unavoidable, as where doubt existed in the minds of the foundrymen in question, the accident was placed into this group rather than in any of the others.

The detailed statement of the returns, arranged as to States, and kind of accident accompanies this report. A summary of the totals would be as follows:

Accident due to:	Slight	Serious	Fatal	Total	No. reporting	Loss in $
1. Personal Carelessness	1,974	140	4	2,118	123	$10,106 39
2. Careless Work	516	39		555	33	4,643 25
3. Inattention in Shop	227	23		250	19	612 00
4. Intoxicants	4	3		7	4	33 00 and 1 foundry
6. Unavoidable Accidents	1,547	159	3	1,709	90	6,858 35
7. Neglect of Safety Devices	83	7	1	91	9	702 00
8. Disobedience of Orders	79	12	2	93	20	3,531 50
9. Taking Chances	118	24		142	27	2,093 18
10. Inferior Materials used	24	4		28	5	123 25
11. Employee's Ignorance	235	13	1	249	15	1,135 50
	4,807	424	11	5,242	345	$29,838 42 and 1 foundry

As the gathering of this information must have put some of the foundries kind enough to reply to considerable trouble, it is but meet that the sincere thanks of the Committee be tendered to each and every firm so contributing. It also shows the great

interest taken by the management of every foundry replying in holding down the number of accidents to the lowest possible figure by attention to the subject.

Respectfully submitted,

Thos. D. West, Chairman.

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STATE	No. reporting	No. in State	% reporting	No accidents	PERSONAL CARELESSNESS					CARELESS WORK				INATTE TO SE CONDIT		
					Slight	Serious	Fatal	No. Items	Cost $	Slight	Serious	No. Items	Cost $	Slight	Serious	No. Items
Alabama	5	95	5.3	3	22			1	103 10							
Arizona	1	8	12.5	1												
California	32	165	19.3	17	4									1		
Canada	72	554	13.0	50	129	2		3	373 50	52	2	1	13 00	5		
Canal Zone	1	2	50.0		1			1	12 00					1		
Colorado	6	52	11.5	3	3			5	405 00	1						
Connecticut	25	157	15.9	20	31	7				10	1	1	25 00		1	1
Delaware	3	19	15.8	2	26											
Dist. Columbia	3	12	25.0	2	3			1	7 00					1		
Florida	5	14	35.7	2	4			3	1,037 00							
Georgia	8	85	9.4	4	7			1	15 00							
Hawaiian Islands	1	4	25.0	1												
Illinois	84	415	20.2	37	444	40	2	8	936 00	117	16	3	200 00	108	12	1
Indiana	36	247	14.6	23	19			1	5 50	6		3	25 00			
Iowa	14	133	10.5	10	1			1	2 00							
Kansas	7	59	11.9	5	2											
Kentucky	2	65	3.1	1	3	1										
Louisiana	3	48	6.3	2	4											
Maine	8	48	16.7	5	2							1	3,000 00		1	
Maryland	12	61	19.7	7	20	5		1	10 00	2				1		
Massachusetts	54	238	22.7	31	67	4		9	2,467 50	3		1	10 00	1		
Michigan	58	325	17.8	40	33	1		7	79 00	4		3	650 00	13		4
Minnesota	15	118	12.7	10	26	1		3	177 00						1	1
Mississippi	2	22	9.1	2												
Missouri	13	142	9.2	7	24			6	247 00					2		2
Montana	2	8	25.0	1	11			1	10 00							
Nebraska	1	27	3.7	1												
New Hampshire	2	36	5.6	2												
New Jersey	44	243	18.1	20	75	2		3	183 00	14	6			6	1	1
New Mexico	1	3	33.1	1												
New York	141	623	22.6	79	300	31		18	1,070 85	35	7	2	20 00	19	2	2
North Carolina	6	66	9.1	4	6			1	28 00							
North Dakota	1	5	20.0	1												
Ohio	104	623	16.7	67	201	9		14	260 50	80	3	4	290 95	41	1	4
Oklahoma	1	16	6.3	1												
Oregon	12	42	28.6	7	6											
Pennsylvania	157	836	18.8	97	178	17	2	17	1,554 41	34		5	103 40	5	1	2
Rhode Island	9	41	21.9	5	41	2		2	50 67	6					2	
South Carolina	4	29	13.8	2	3			1	5 00							
South Dakota	4	8	50.0	2	3			1	7 50							
Tennessee	23	87	26.4	15	42	2		2	130 00	10		1	25 00	1	1	
Texas	9	74	12.2	6	7			1	3 35					1		
Utah	3	21	14.3	3												
Vermont	9	32	28.1	8	12			1	25 00							
Virginia	12	82	14.6	9	3											
Washington	12	69	17.9	4	11	2		4	668 50	5	1	2	35 00			
West Virginia	11	47	23.4	6	7			1	2 50							
Wisconsin	46	230	20.0	25	193	14		5	231 00	132	3	5	234 50	21		1
Other States		40														
Total	1,084	6,366	17.0 %	651	1974	140	4	123	10,106 39	491	38	32	4,643 25	227	23	19

INATTENTION TO SHOP CONDITIONS				INTOXICANTS				UNAVOIDABLE ACCIDENTS					NEGLECT OF SAFETY DEVICES					DISOBEDIENCE OF ORDERS					C	
Slight	Serious	No. Items	Cost $	Slight	Serious	No. Items	Cost $	Slight	Serious	Fatal	No. Items	Cost $	Slight	Serious	Fatal	No. Items	Cost $	Slight	Serious	Fatal	No. Items	Cost $	Slight	Serious
								15			1	126 00												
1								2			1	18 00		1		1	483 00							2
5								52	60	3	3	397 75	10					1					2	2
1								2			/							1					1	
	1	1	35 00					37	6		3	131 00	1						2		1	10 00		2
								1										1						
1																								
								14	1		2	105 00												
108	12	1	96 00	1	2	1	foundry	345	27		8	469 00	13	3	1			31	1		2	21 00	50	4
								16	2		5	111 00	1			1	10 00	2	2		3	2,037 00		
								2			1	4 75											1	
																		1						
								1																
	1																							
1								2	3															
1				1		1	10 00	30	4		5	179 00						3			1	100 00	13	
13		4	30 50					33	1		4	49 00	1					1			1	2 00		
	1	1	62 00					4			1	3 00	1			1	40 25	1						
2		2	25 00					37			3	214 00							1					
6	1	1	130 00		1			31	7		4	749 00		1		1	30 75	2					1	
19	2	2	69 00	1		1	5 00	328	23		9	1,221 81	1	2		3	74 00	6			3	103 50	4	6
								1			1	15 00												
41	1	4	125 50					210	7		11	904 50	30			2	64 00	7	1	1	4	65 50	19	
5	1	2	3 50					167	9		17	1,522 79						9	3	1	5	292 50	7	5
	2							9					1					1						
								6			2	210 00												
								1					1											
1	1			1		1	18 00	16	1									1					10	
1																		1					1	
								10			2	165 00												
								1			1	5 00						1						
21		1	35 50					165	8		5	107 75	22					9	2				6	1
227	23	19	612 00	4	3	4	33 00 and 1 foundry	1,547	159	3	90	6,858 35	83	7	1	9	702 00	79	12	2	20	3,531 50	118	2

	Taking Chances				Inferior Materials Used				Employee's Ignorance.					Accident Premiums Paid		State of Business			State
	Slight	Serious	No. Items	Cost $	Slight	Serious	No. Items	Cost $	Slight	Serious	Fatal	No. Items	Cost $	No. Items	Cost $	Dull	Fair	Full	
														2	400 00		2		Alabama
																			Arizona
		2	1	200 00										9	715 00	1	6	4	California
	2	2							6					8	1,161 50	5	25	7	Canada
	1								2									1	Canal Zone
														1	75 00	1	3	1	Colorado
00		2	1	800 00					5			1	25 00	2	10,556 25	3	4	3	Connecticut
																2			Delaware
																	2		Dist. Columbia
									1								1	1	Florida
														2	350 00		1		Georgia
																			Hawaiian Islands
00	50	4	3	336 50	18	4	1	9 00	30	2		3	17 50	14	3,688 94	6	16	1	Illinois
00									10					5	11,611 20	4	15	1	Indiana
	1		1	22 50										3	356 00			4	Iowa
																		4	Kansas
														1	65 36				Kentucky
																			Louisiana
														2	294 50		3	1	Maine
														4	554 62	3	3		Maryland
00	13		3	54 00					5					15	2,782 98	3	19	5	Massachusetts
00														12	1,385 70	4	22	4	Michigan
														3	199 00		6	2	Minnesota
																		2	Mississippi
														3	1,158 50	5	5		Missouri
																			Montana
																	1		Nebraska
																	1		New Hampshire
	1				1									8	2,233 22	7	9	3	New Jersey
																			New Mexico
50	4	6	5	187 00					1			1	16 00	24	8,250 27	19	36	15	New York
														2	133 50	2	1		North Carolina
																			North Dakota
50	19	2	3	40 00	1		1	75 00	19	1		5	87 00	26	4,194 84	18	23	5	Ohio
																			Oklahoma
																			Oregon
50	7	5	7	372 18	3		2	24 25	6	1		2	200 00	18	3,397 12	18	41	11	Pennsylvania
														4	741 29	1	5		Rhode Island
														1	25 00		1	1	South Carolina
																	2	2	South Dakota
	10		1	66 00										5	474 50	7	8	1	Tennessee
	1													1	75 00		2	3	Texas
																	1		Utah
														1	40 00	1	1	1	Vermont
														1	30 00		3	1	Virginia
										1		1	600 00	1	350 00	1	3	1	Washington
														1	2 00	1	2	1	West Virginia
	6	1			1		1	15 00	124	33	1	2	180 00	10	3,376 29	1	16	4	Wisconsin
																			Other States
50	118	24	27	2,093 18	24	4	5	123 25	207	40	1	15	1,135 50	190	48,679 58	114	302	71	

ACCIDENT STATISTICS, AMERICAN

No. .... Report by ....

Accidents Caused by	Number Killed Outright	Number Fatally Injured	No. Se[verely] Inj[ured]
1. Personal carelessness......................			
2. Careless work,......................			
3. Inattention to surrounding shop conditions,..........			
4. Intoxicants,......................			
5. Smoking,......................			
6 Unavoidable Accidents,......................			
7. Neglect of Safety Devices provided,................			
8. Disobedience of orders,......................			
9. Taking chances,......................			
10. Inferior workmanship on materials used............			
11. Ignorance on part of employees			

Total number of accidents.................................... ....

Average total number of employees during the time specified,.................. ....

Number killed or injured through their own fault,........................ ....

Number killed or injured through fault of co-employees,.................... ....

Number killed or injured through burns, ...

Number killed or injured through bruises, ...

Average state of business during time: dull, fair, or full,................ ....

Period of greatest number of Accidents............................ ....

Amount of Accident Insurance premiums paid out to cover this time,............ ....

The Committee on the Prevention of Accidents of the American Foundrymen's Association urgently requests that you kindly fill out the above blank and mail it at your early convenience to RICHARD MOLDENKE, SECRETARY, WATCHUNG, N. J. The information contained is considered strictly confidential, and will be used only for compilation of a general report showing the status of accidents in the Foundry Industry. No names will be used, but only the summary of the figures. For that reason you are urged to assist in the cause, in view of the drastic legislation constantly coming up, most of which could be avoided if the real causes of accidents were fully known.

The report will be published in the Transactions of the Association, and also given out by the Technical Press of the Country. Any information cheerfully furnished by the Chairman, THOMAS D. WEST, SHARPSVILLE, PA, on request.

, AMERICAN FOUNDRYMEN'S ASSOCIATION

From July, 1907, to July 1908

ber Fatally njured.	No. Seriously Injured	Number Slightly Injured	Cost of Attention to Cases		Cost of repairs made necessary		Loss through fire resulting		TOTAL COST	
			$		$		$		$	

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ociation urgently
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f accidents in the
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given out by the
an, THOMAS D.

REMARKS:

NOTE: Under this head, kindly give anything of interest in connection with the prevention of accidents in your establishment, from which others can learn.

American Foundrymen's Association

FROM THE COMMITTEE ON INDUSTRIAL EDUCATION.

NOTE BY THE SECRETARY.—The question of Industrial Education is attracting more and more attention in this Country. Not only manufacturers (who are directly interested), but the general public, legislators, and even the leaders of the labor movement, are getting quite alive to the situation, each class looking, perhaps, at the problem rather strongly from its own standpoint. A study of the current literature only emphasises the fact that any and all attempts of individuals or associations to establish schools for the training of our youth for vocational life, while by no means wasted, are simply so many drops of water in a very big bucket.

It is necessary that this work be made part of the public school system of this Country, that the curriculum be arranged accordingly, and primarily the teaching staff be trained to enter into the necessities of the case in a whole-hearted and effective way. We have too much over-education of boys and girls, few of whom can ever hope to fill important places in life, and hence there exists today a horde of clerks and stenographers with white hands, and in immaculate linen, who are as the lilies of the field and unfortunately are envied by those whom necessity compels to get up and be doing something useful. Far better only the three "R's" for our youth, when combined with a useful industrial education, and a University training only for the exceptionally bright student, than as things are now.

As long as we live off the fat of the land, and are wasting our natural resources with a prodigality awful to contemplate, things may last with more or less freedom from disturbance other than financial ups and downs; but when we are down to hard tack, and the more favored nation has to scheme for its very existence while its resources last, to keep from being overrun by its starving neighbors, then we will wish that our Nation was one

of effective workers. The subject is a big one and fraught with dangers as well as possibilities for relief.

The work of our Committee on Industrial Education is attracting much attention among prominent educators of the Country, the Chairman, Mr. P. Kreuzpointner, of Altoona, being kept busy disseminating information concerning American and European needs and accomplishments. A recent inquiry from the Superintendent of Schools of Seattle, Wash., required a rather longer answer than usual, and extracts of the reply sent Mr. Frank B. Cooper, by our Chairman, will interest the membership.

"I take pleasure in answering your query of Nov. 10th, whether the United States is likely to lose its industrial standing because of our unpreparedness for training those who are to enter industrial life.

"Being a product of Germany's, respectively Munich's industrial schools, as they existed fifty years ago, when I was an apprentice from 1856 to 1861, and having followed the development of European systems of industrial education ever since, knowing the intense pressure of their economic conditions, knowing, as a member of two European technical societies, the drift of their industries approximately well, I answer your question in the words of prominent foreign engineers who visited this country, studied its industrial conditions, and gave me their personal opinions in conversation here in Altoona. The concensus of their opinion seems to be that, unless we adopt a system of thoroughly training our industrial workers in a manner similar to their own, this country cannot keep up its present industrial pace for more than twenty years because the education of the mass of the people—necessary to meet the ever tightening economic conditions, due to increase in density of population and decrease in quality, or quantity, of our resources, or both—is inadequate and inefficient.

"In 1904, the German government sent a commission of six picked educators to study our educational facilities. They went about very quietly, they avoided dinners, publicity, brass bands, but with German thoroughness investigated and reported that it will be many years before our industrial education will approach the effectiveness of theirs, if ever.

"In 1903, the superintendent of industrial education of the Empire of Austria had some correspondence with me and among other things asked me my opinion as to the probable fate of Austria's small industries, which are the mainstay of that country because of lack of resources to support extensive concentrated manufacturing, these small industries being hard pressed by the flooding of Austria's cities with American goods. I told him that if Austria could keep its small industries above water for twenty years, they would not be much troubled by American competition for two reasons: First, that so little attention was paid in this country to technical education in our schools, that when this necessity for technical and scientific training is grasped and attempted, the psychological condition of the present growing generation will be too far advanced. It will not be receptive for philosophical thinking. The mind of present and past generations will have run exclusively along mechanical lines and mathematics in the higher branches, and along lines of manual dexterity in our manual training and trade schools. Thus a new generation will have to be made receptive, psychologically, to absorb and develop, upon a national scale, the mental power of readily grasping the depth and breadth of technical education, such as we need to bring us approximately to the standard of industrial education of our foremost foreign competitors.

"Second, because of the absence of this technical training and the wasteful habits of the people and its workmen, habits which are the inheritance of a time when the people believed and many still believe, that our resources are inexhaustible and hence could be wasted with impunity; when saving was a badge of meanness and niggardliness. These wasteful habits and lack of technical knowledge necessary to make the best use of our remaining resources, cause them to diminish so rapidly that the next generation will have to exercise economy to keep enough for the growing home population, and little will be left to throw the products of our industries upon the markets of our competitors in competition with their home industries.

"And even if we could instill into the people, within one year, the desire for technical education and the receptiveness of the mind of the masses to absorb technical teaching and knowledge

and, with our usual energy, apply the knowledge, we would still be at a great disadvantage because our foreign competititors are used to pinched conditions and, if necessary, can tighten their belts still more, while our mechanics do not know as yet what a tight belt means, much less are they in a willing condition to tighten it a notch or two.

"I have spoken with mechanics who told me that they would cause a revolution if they could not have two kinds of pie in their dinner pails. While this is easier said than done, nevertheless it indicates the spirit which, when our economic pressure becomes more severe, will increase our disadvantage when competing with people and mechanics of foreign countries, millions of whom think it a treat to have pie at Christmas and Easter and Feast days, or think they are well off if they have a scrap of meat once a week.

"At the annual meeting of the Eastern Manual Training Association, in 1902, I was amused when an enthusiastic domestic science teacher, in a well prepared and creditable paper, detailed the economic value of this, that, and the other prepared dishes, and the blessings thus conveyed by the domestic science department of a manual training school into the homes of the American mechanic. I was mean enough to spoil the pleasant illusion by calling attention to the fact that the American mechanic would consider such a diet good enough for the "Dago," the "Dutchman," the "Slovac," but not for him who considers brown bread a badge of poverty and would ostracize the man who would lower himself to such "French penuriousness." I know American mechanics now who declare the common laborer not entitled to a white shirt. I do not comment upon this attitude of mind. I simply state the fact to show our degree of disadvantage whenever the industrially untrained and technically uneducated but mechanically dexterous American mechanic will have to face the economic pinch and the competition of, say, the highly skilled Belgian mechanic with his blue blouse and wooden shoes, his lentils and peas and sour milk, and perhaps a bit of meat on Sunday.

"The other day during noon hour I passed along a street where the car track was being relaid, and the men, some forty, were sitting along the curb eating their dinner. They were all Ameri-

cans, apparently, since with the beginning of hard times last year some corporations discharged all Italian laborers to make temporary room for unemployed Americans. I am always studying the manner of living of working men, and walked slowly along to see what they had in their dinner pails. I did not see a single piece of brown bread with any one, and while some had an egg or a piece of meat, there were many pickles, jellies and other poorly nourishing material, costing money but having little food value. I wish I could have brought some domestic science teachers along, or taken them through some industrial establishments during dinner hour so that they might learn, not how to teach the children of the American mechanic to prepare dishes which the child's parents reject as good only for the 'Dago,' but to teach them how to get food value for the money expended.

"Whenever the pinch comes, and it will come soon enough at the rate we are traveling, and the belt has to be tightened, the cheaper and equally nourishing diet will come of itself and the domestic science department of our schools will have prepared the ground for new conditions by training in that skill and knowledge which a turn to changed conditions of life makes possible without great hardship. You see the interdependence of industrial education for the sexes if we want to counteract the forces which now tend to make us lose our industrial standing in competition with our foreign rivals.

"To raise money for the establishment of a comprehensive system of public trade and industrial schools should not be so difficult for us if poor Belgium, Germany, and Austria can do it. The city of Munich, of 520,000 inhabitants, supports 48 trade schools and 12 manual training schools. If we had as many industrial schools as the little kingdom of Wuertemberg, we ought to have 30,000 schools, in proportion to population. Pennsylvania alone ought to have 1,000. A friend of mine in the city of Hagen, Prussia, who is on the school board, wrote me that for this year, 1908, they were to expend thirty-three per cent. (33%) of the total taxation of the city for school purposes and even that does not provide for this year's increase of population.

"If we would ask an American community to expend that much the school board would be denounced bitterly. In the 1907 annual school report for the city of Hagen I find the expenditure per pupil

of the "Realgymnasium" the "Gymnasium" and the "Unterklassen" $88.62—722 pupils. The expenditure per pupil in the 'Oberrealschule' $81.67—496 pupils. The expenditure per pupil in the 'Lehrerinen-Seminar und Seminarvorschule' $20.30—670 pupils. The expenditure per pupil in the 'Hoehere Maschienenbauschule,' including evening and Sunday classes, $92.20—240 pupils. The expenditure per pupil in the elementary schools $18.50—14,379 pupils. I do not know what the city's budget was for 1907, but for 1908 it was three million Marks, one Mark equalling 24.8 cents, and my friend wrote me that there were more than one million Marks of that three million appropriated for schools. There were 600 girls in the domestic science or 'Haushaltungsschule' and all the boys, of course, were obliged to go to some kind of industrial school until 17 years of age. See why the American consul at Stuttgart, Wuertemberg, complains that less and less is imported from the United States and more and more is exported to the United States.

"During the last five years Germany has doubled the sale of machinery to the United States, Belgium has trebled it. Yet we proclaim that we are the greatest machine builders in the world. From a report of a special agent, issued by the United States government last July, to investigate trade conditions in Mexico, I take the following: 'While the trade returns afford just cause for a certain degree of satisfaction, it must not be forgotten that competitors of the United States, while holding in comparison but a small percentage of Mexico's trade, are at the same time making more rapid progress.' I know of a case where an American agent for a furniture house went to a Mexican town, had to hire an interpreter, was ignorant of conditions, stayed a week and did not sell a cent's worth. Meantime a German agent came along, who could speak Spanish, knew the money and trade conditions, loafed around a week to study the lay of the land and the second week sold $10,000 worth of furniture.

"But even if we could command the use of $500,000,000 and could train 100,000 teachers in a week, we would still be handicapped by the retarding traditions of our schools, especially the unfriendliness of the high school towards industrial education in it. We would be handicapped by the lack of the co-

operative spirit which makes the school people, the industrial people, the professional people, the lodge, the society, club, and church people, the labor union and non-labor union people, the American, Irish, Scotch, German, Englishman, each go his own way without harmony of purpose and unity of action. In Germany and Belgium these astonishing sacrifices for education are made possible by the unrestrained co-operation of all social forces without reserve and distinction. When it comes to education, the capitalist and the laborer, the monarchist and the socialist work in perfect harmony.

"Speaking now from a purely economic standpoint, our high tariff is also a disturbing factor in as much as it created a sense of security from outside interference in the great mass of industrial workers, and an unwillingness to train the mind where legislation would protect us from undesirable mental exertion to learn economic production by learning the secrets of the laws of nature, viz: science and techniques. Where a large concern could easily learn economic ways of production by sending some bright man abroad who, without stealing secrets or dishonesty of any kind, could learn for an expenditure of traveling expenses better ways of doing things more economically, months and years were spent and material without end was wasted to learn the same thing, painfully and laboriously by experimentation. But now that our great concerns, in their management and methods of production, are coming down to rock bottom and a scientific basis, they encounter the incomprehensibility of the workmen for scientific and economic measures and the ingrained habits of wastefulness, to overcome which disciplinary measures are resorted to, must be resorted to in many instances. These, not being understood, are resented as interfering with American independence, create friction and misunderstanding where there ought to be co-operation and confidence. While, for instance, in Germany, with all the bitterness between socialists and capitalists, the technical civic training of the workers lets them understand technical economic measures and methods of management in the shop; hence the avoidance of unnecessary friction due to lack of technical knowledge.

"Summing up, then, the various points in answer to your

question whether the United States is likely to lose its industrial standing because of the absence of systematic training of those who enter industrial life, the answer must be in the affirmative as long as we make no concerted and systematic effort as a nation to supply that training. The foundation of our phenomenally rapid industrial development and strength thus far has rested upon the immense wealth of our resources and our free institutions and pioneer spirit of independence which fostered an individualism that rioted in our resources without thought of consequences; while our competitors, due to scarcity of resources and density of population, had to study the laws of nature, to make use of these laws, through the application of science and technique, to the best advantage, to make two blades of grass grow where one grew before.

"Their inability to riot amidst limited resources imposed upon them self-control and habits of economy, or starve. This, in turn, produced their splendid system of education, their self-sacrifice, their harmony of purpose and unity of action to maintain and perfect that education. To the degree then as we are approaching this same economic condition, to the degree as our resources diminish, to the degree as density of population and the imperative necessity for greater economy in the use of our resources circumscribes the old traditional pioneer spirit and checks the rampant individualism, to that degree, we, in the United States, must adjust and adapt our educational system to those new social and economic conditions where the study of the laws of nature, the application of scientific and technical knowledge, a sincere co-operative spirit, a high sense of civic duty and responsibility must make up for diminished wealth of resources and circumscribed individual activity.

"This is becoming and has become a national issue, and this issue has to be met by an intelligent, liberally supported and universally extended system of trade and industrial schools as a continuation of our elementary schools. And to the degree as we ignore these economic changes, to the degree as we hesitate to recognize the educational necessities of the economic and industrial situation, to the degree that we refuse to make the necessary sacrifices for the industrial and technical training of the mass of our industrial workers, who, in the end will rule our country, by sheer force of numbers if not by intelligence; to that degree will the United States lose its industrial and, as a consequence, its political standing."

Very truly yours,

Paul Kreuzpointner,

Chairman.

American Foundrymen's Association

MOLDING SAND TESTS

Bulletin No. 1. **By the Secretary.**

Among the series of investigations undertaken by our Association, to defray the expense of which a fund was recently raised by subscription, probably the most elaborate will be an investigation of the molding sands used in American foundries.

It is not only intended to carry through the ordinary tests usually made in judging sands, but to apply methods approximating closely actual foundry conditions, such as the effect of molten iron and the extent of injury thus caused to a sand, methods of preparation of the sand, and the like.

A request for sand samples, a nail keg of each, has so far brought sixty-four molding sands, from all parts of the country, the result of the fineness tests on which are communicated in this bulletin. Each firm contributing has been given a letter of the alphabet as a designation, which will be found in the tables. The names to correspond are known only by the respective donors, so that they may judge their own sands in comparison with the others. In this way no business advantage can be taken in matters competitive. When all the results are together, a sand may be followed through the series of tests, and its value studied by comparison.

It is proposed to issue Bulletins as fast as the results are obtained, and to finally collect all the data for a report on the subject. In the meantime, as the convention preparations will in-

terrupt the work for a few months, it is hoped that many more sands will be sent to the Association, as they can easily be added to the list, the work not having progressed beyond a stage where this will interfere. There are many local sands used by founders, which the users might like to compare with the standard articles, which will be found in the tables under those letters which have three to ten numbers to them. It will give the Association much pleasure to do this work for the benefit of the knowledge obtained, and it is hoped that this offer will be heartily responded to. Communicate with the Secretary on the subject. (To Dr. R. Moldenke, Watchung, N. J.)

TESTS OF FINENESS.

All sands as received were stored in a warm room and held there until completely dry. Each sand in turn was spread upon a clean concrete floor, the lumps well crushed, and then mixed thoroughly with a molder's shovel. The heap thus made—all of the sand being used—was then divided into quarters, as in getting an ore sample, and two opposite quarters removed back to the storage receptacle again. The remaining two quarters were then again mixed and divided into quarters, two of which, opposite and at right angles to the previous quarters, were again returned to the receptacle. This was repeated—all lumps appearing being carefully crushed—until a sample of several pounds remained. This was then lightly pressed over by the shovel just sufficient to see that no grains of sand were stuck together, but not rubbed to break the grains or separate out the clay. From this sample, 2,500 grains (a little over one-third of a pound, Advp.) were kept for the fineness test, and the balance reserved for the rational analyses.

The 2,500 grains were next placed in a set of sieves and shaken until properly sized. These sub-divisions were then weighed and the percentage calculated. Table 1 gives the figures. First, everything that remained on the 20-mesh sieve (this means twenty meshes to the inch, or 400 to the square inch of sieve.) Then what remained on the 40-mesh sieve after passing through the twenty-mesh. Next the 40 to 60-mesh. Then the 60 to 80, the 80 to 100, and finally what passed through the 100-mesh sieve. Material that will pass through 10,000 openings in a space an inch square is pretty fine, and yet some of the sands of the list, known to be most excellent in quality for brass and iron art castings, had a percentage in the nineties passing through the 100-mesh sieve.

The last column of the table gives the average fineness in percentages, a hypothetical sand in which every particle passes

through the 100-mesh sieve being considered 100%. This percentage of average fineness, which is approximate and intended to serve for comparison only, is calculated out as follows:

Everything passing through the 100-mesh is considered 100, Everything between the 80 and 100 mesh may be called 90, similarly between 60 and 80, 70, between 40 and 60, 50, between 20 and 40, 30, and what did not pass through the 20, can be called 10. Hence the calculation would be, for H-1 for instance:

.08	x 10=	.80	
.24	x 30=	7.20	
6.80	x 50=	340.00	
8.84	x 70=	618.80	
9.76	x 90=	878.40	
74.28	x 100=	7428.00	
100.00		9273.20	or 92.73% fine.

or for H-4, as follows:

.08	x 10=	.80	
4.92	x 30=	147.60	
36.96	x 50=	1848.00	
18.80	x 70=	1316.00	
7.60	x 90=	684.00	
31.64	x 100=	3164.00	
100.00		7160.40	or 71.60% fine.

A glance through the tables will show some interesting things, especially later on when tests of air penetration under given conditions, the analysis giving the clay content and the nature of this clay, as well as the shape of the sand grains, have been recorded. As it is, some sands will be seen to have their bulk ranging between certain limited sizes, while others have the sizes scattered about the whole range. Two sands, I-1 and O-5, kindly donated, are included here, and will be on the analysis table, but

not thereafter, as they are not intended for molding purposes.

The type of this table will be held for additions in case further sands are sent to the Association, and after a resonable time has elapsed, final copies struck off for the complete report, and the entries closed.

Table No. 1--Fineness.

Mark	Pr cent over 20 mesh	Pr cent b'tween 20-40 mesh	Pr cent b'tween 40-60 mesh	Pr. cent b'tween 60-80 mesh.	Pr. cent b tween 80 100 mesh.	Pr cent below 100 mesh	Pr cent fineness
A 1	.20	1.44	1.32	1.40	.24	95.40	97.69
B 1		5.76	28.40	19.68	8.80	37.36	74.98
2		.20	7.28	4.40	3.24	84.88	95.07
3	.20	21.64	34.92	17.60	6.52	19.12	61.29
4			.40	3.04	2.08	94.48	98.68
5	.20		5.92	6.00	3.36	84.52	94.72
6		4.20	13.92	33.36	17.36	31.16	78.36
7	.28	19.84	8.36	5.64	6.36	58.92	78.33
8			6.52	3.92	1.52	88.04	95.41
C 1		.04	4.28	4.52	2.92	88.24	96.18
2		2.40	20.00	16.28	8.28	53.04	81.01
3	.04	14.40	36.00	16.80	7.72	25.04	66.07
4	.24	29.60	32.00	18.40	2.84	16.92	57.26
5	9.24	37.44	21.60	8.20	6.80	16.72	51.54
6		8.24	27.40	13.00	7.40	43.96	75.89
D 1	.08	1.12	1.92	1.40	1.24	94.24	97.64
2	.44	2.80	9.00	16.32	16.56	54.88	86.59
3	1.84	31.40	19.88	10.12	9.00	27.76	90.46
E - 1	.24	1.60	10.44	6.40	11.68	69.64	99.53
F - 1		.12	.40	.44	.52	98.52	99.40
2		.12	.56	.60	.56	98.16	99.40
3		.60	3.08	13.00	23.52	59.80	91.62
4	.08	8.36	17.60	28.24	20.16	25.56	74.79
5	.20	11.80	21.80	12.16	25.28	28.76	74.48
6	.28	35.04	32.00	13.28	9.52	9.88	54.28
G - 1		.08	8.24	3.72	2.08	85.88	94.50
2		8.00	29.20	22.96	12.00	27.84	69.55
3		15.72	28.00	18.00	7.60	30.68	68.83
4		6.00	13.20	16.32	10.00	54.48	83.30
5		31.40	38.04	12.00	4.60	13.96	54.94
6	.68	30.80	8.92	4.56	5.60	49.44	71.44
G–7	2.84	40.00	27.20	9.60	4.80	15.56	41.23
8	.04	.60	4.20	5.28	3.20	86.68	95.54

Mark	Pr. cent over 20 mesh	Pr. cent b'tween 20-40 mesh	Pr. cent b'tween 40-60 mesh	Pr. cent b'tween 60-80 mesh	Pr. cent b'tween 80-100 mesh	Pr. cent below 100 mesh	Per cent fineness
H -1	.08	.24	6.80	8.84	9.76	74.28	92.73
2	.04	.32	7.36	11.56	11.48	69.24	91.44
3	.04	3.60	14.44	22.88	12.36	46.68	81.12
4	.08	4.92	36.96	18.80	7.60	31.64	71.60
I - 1		2.16	44.84	36.88	10.64	5.48	* 63 94
K - 1	.04	.16	.88	4.52	9.04	85.36	97.15
L - 1	.16	1.56	7.04	16.40	19.24	55.60	88.40
2	8.72	55.00	10.40	5.60	2.28	18.00	36.54
3	4.52	19.68	11.60	8.28	5.64	50.20	73.31
4	.08	3.44	4.00	8.84	14.80	68.84	91.39
5	.16	13.88	5.60	3.84	7.52	69.00	85.44
6	.36	12.56	15.20	11.12	7.48	53.28	79.20
7		1.36	30.24	22.80	14.08	31.52	75.69
8	.96	9.56	13.68	16.80	6.80	52.20	79.88
9		9.80	41.24	19.40	7.40	22.16	65.26
10	4.60	33.44	25.24	14.24	5.36	17.12	55.02
M - 1		1.04	1.36	4.40	3.72	89.48	96.60
2		.84	7.72	9.76	11.80	69.88	91.44
3	.04	1.44	12.08	16.80	11.32	58.32	86.74
4		.04	3.04	5.36	6.12	85.44	96.23
5	.04	3.92	14.24	17.04	11.84	52.92	83.80
N - 1	1.48	8.24	35.56	20.68	6.64	27.40	68.25
2	3.20	20.16	48.80	11.20	3.68	12.96	54.81
3	.80	25.44	35.52	13.88	5.64	18.72	58.91
O - 1	.04	1.04	1.88	2.60	5.00	89.44	97.01
2	2.04	6.60	12.48	8.48	6.00	64.40	84.16
3	.40	2.92	27.20	20.00	10.92	38.56	76.90
4	1.28	11.64	20.68	17.40	8.60	40.40	74.38
5	32.96	30.00	16.48	6.24	3.20	11.12	§ 38 90
P - 1		.08	10.52	8.60	9.00	71.80	91.20
2		.12	6.88	7.52	8.60	76.88	93.36
3		.04		.20	1.48	98.28	99.94
4		.08	.08	.52	6.40	92.92	99.11
5		.28	.40	.48	60	98 24	99 40
R - 1	.04	14.52	30.84	18.72	8.20	27.68	67.94
S - 1	.48	1.16	15.20	10.68	9.84	62.64	86.97
T-1	.40	19.20	9.80	5.88	4.84	59.88	79.05
2	.32	14.40	14.48	9.68	3.44	57.68	79.14

* Core Sand.

§ Fire Sand.

American Foundrymen's Association.

FROM THE COMMITTEE ON STANDARD SPECIFICATIONS FOR FOUNDRY IRON

Note by the Secretary: The following proposed Specifications for Foundry Pig Iron are part of the Report of the Committee on the subject appointed at the Toronto Convention last year, with power to represent the Association in conference with a similar committee from the American Society for Testing Materials.

The committee has gone over the ground carefully, and after a number of conferences and thorough discussion, presents the Specifications herewith as the joint proposal of the American Foundrymen's Association, and the Pig Iron Committee of the American Society for Testing Materials. In addition, members of a Committee appointed by the Philadelphia Foundrymen's Association, and of the Eastern Pig Iron Association have been in conference with the two Committees in question, so that the document herewith given represents what may be considered acceptable to the great interests involved as indicated by their representatives.

In order that the membership may be informed of this previous to the Cincinnati Convention, so that opportunity is had for discussion preliminary to final action, the Committee has asked your Secretary to distribute the specifications proposed at this time, in order that wide publicity may result. Messrs. H. E. Field, Chairman, of Mackintosh, Hemphill & Co., Pittsburg, Pa.; Henry A. Carpenter, of the General Fire Extinguisher Co., Providence, R. I.; and Stanley G. Flagg, Jr., of Stanley G. Flagg & Co., Philadelphia, Pa., are the members of the American Foundrymen's Association Committee.

PROPOSED STANDARD SPECIFCATIONS FOR BUYING FOUNDRY PIG IRON

It is recommended that Foundry Pig Iron be bought by analysis, and that when so bought these Standard Specifications be used.

PERCENTAGES AND VARIATIONS

In order that there may be uniformity in quotations, the following percentages and variations shall be used.

(These specifications do not advise that all five elements be specified in all contracts for pig iron, but do recommend that when these elemeuts are specified that the following percentages be used).

SILICON

(0.25 allowed either way)

1.00	— (La)	(Code)
1.25	— (LaX)	
1.50	— (Le)	
1.75	— (LeX)	
2.00	— (Li)	
2.25	— (LiX)	
2.50	— (Lo)	
2.75	— (LoX)	
3.00	— (Lu)	
3.25	— (LuX)	

SULPHUR.

(Maximum)

0.04	— (Sa)	(Code)
0.05	— (Se)	
0.06	— (Si)	
0.07	— (So)	
0.08	— (Su)	
0.09	— (Sy)	
0.10	— (Sh)	

TOTAL CARBON.

(Minimum)

3.00	— (Ca)	(Code)
3.20	— (Ce)	
3.40	— (Ci)	
3.60	— (Co)	
3.80	— (Cu)	

MANGANESE.

(0.20 either way)

0.20	— (Pa)	(Code)
0.40	— (Pe)	
0.60	— (Pi)	
0.80	— (Po)	
1.00	— (Pu)	
1.25	— (Py)	
1.50	— (Ph)	

PHOSPHORUS.

(0.150 either way)

0.20	— (Ma)	(Code)
0.40	— (Me)	
0.60	— (Mi)	
0.80	— (Mo)	
1.00	— (Mu)	
1.25	— (My)	
1.50	— (Mh)	

In case of Phosphorus and Manganese, the percentages may be

used as maximum or minimum figures, but unless so specified they will be considered to include the variation above given.

SAMPLING AND ANALYSIS

Each car load, or its equivalent, shall be considered as a unit in sampling.

One pig of machine-cast, or one half pig of sand cast iron shall be taken to every four tons in the car, and shall be selected from different parts of the car.

Drillings shall be taken so as to fairly represent the composition of the pig as cast.

An equal weight of the drillings from each pig shall be thoroughly mixed to make up the sample for analysis.

In case of dispute, the sample and analysis shall be made by an independent chemist, mutually agreed upon, if practicable at the time the contract is made.

It is recommended that the standard methods of the American Foundrymen's Association be used for analysis. Gravimetric methods shall be used for Sulphur analysis, unless otherwise specified in the contract.

The cost of resampling and and reanalysis shall be borne by the party in error.

BASE OR QUOTING PRICE

For Market Quotations an iron of 2.00 per cent in Silicon (with variation of 0.25 either way), and Sulphur 0.05 (maximum), shall be taken as the BASE.

BASE TABLE

The following table may be filled out, and may become a part of the contract: "B," or Base, represents the price agreed upon for a pig iron running 2.00 in Silicon (with allowed variation of 0.25 either way), and under 0.05 Sulphur. "C" is a constant differential to be determined at the time the contract is made. (It is recommended that "C" be 25 cents per ton).

(This table is for settling any differences which may arise in filling a contract, as explained under Penalties and Allowances, and may be used to regulate the price of a grade of pig iron which the purchaser desires, and seller agrees to substitute for the one originally specified).

SILICON percentages allow 0.25 variation either way. SULPHUR percentages are maximum.

SULPHUR	SILICON					
	3.50	3.00	2.50	2.00	1.50	1.00
0.03	B+5 C	B+ 4C	B+ 3C	B+ 2C	B + C	B
0.04	B+4 C	B+ 3C	B+ 2C	B + C	B	B — C
0.05	B + 3C	B+ 2C	B + C	B	B — C	B— 2C
0.06	B+ 2C	B + C	B	B — C	B — 2C	B— 3C
0.07	B + C	B	B — C	B— 2C	B— 3C	B— 4C
0.08	B	B — C	B— 2C	B— 3C	B— 4C	B— 5C
0.09	B — C	B— 2C	B — 3C	B— 4C	B — 5C	B— 6C
0.10	B— 2C	B— 3C	B— 4C	B— 5C	B—6C	B— 7C

PENALTIES

In case the iron, when delivered, does not conform to the Specifications, the buyer shall have the option of either refusing the iron, or accepting it on the basis shown in the above table, which must be filled out at the time the contract is made.

ALLOWANCES

In case the furnace cannot for any good reason deliver the iron as specified at the time delivery is due, the purchaser may at his option accept any other analysis which the furnace can deliver. The price to be determined by the Base Table above, which must be filled out at the time the contract is made.

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